BodyAid SOLUTIONS

Level 3 Diploma in Massage Therapy for Sports

MANUAL

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FOCUS AWARDS

Unit 1 Anatomy and Physiology for exercise

Unit 2 Principles of Exercise Fitness and Health

Unit 3: The principles of soft tissue dysfunction

Unit 4: Professional Practice in Sports Massage

Unit 5: Sports Massage Therapy Treatments

Section 1: The Structural Organisation of the Human Body

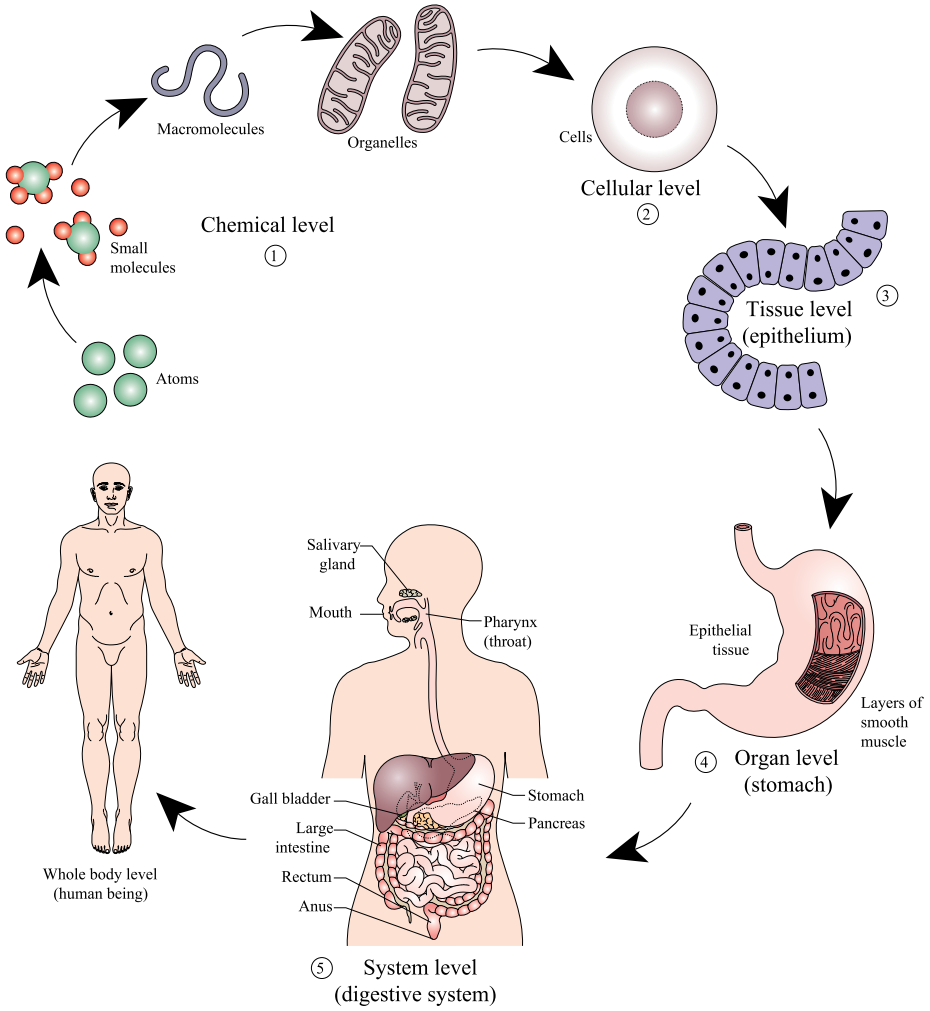
Aim

The aim of this unit is to provide the learner with the knowledge and understanding of the anatomy and physiology of the major systems of the body.

Learning Outcomes

Explore the structural systems of the body and be able to explain their functions
Explain the structure of the skin and its main functions
Know the structure and functions of the skeletal system
Analyse the structure and function of joints, including ligaments, tendons and cartilage
Explain the structure and functions of the muscular system
Know the structure and functions of the nervous system
Explain the structure and functions of the endocrine system
Explain the structure and functions of the cardiovascular system
Explain the structure and functions of the respiratory system
Comprehend the structure of the lymphatic system and its main functions
Describe the structure and functions of the digestive system
Explain the structure and function of the urinary system
Explain the physical, physiological and neurological effects of sports massage on the body

As an organism, the human body is extremely complex. It is made up of trillions of cells that perform many functions. Specialising cells help us to sense, protect, produce, receive, conduct, secrete, produce, distribute and permeate.



Systems

Tissues and organs work in tandem to perform specific functions within the human body. Ten identifiable systems are listed below:

Nervous system
Digestive System
The Skin
The reproductive system
The Endocrine System
The Digestive System
The Urinary System
The Respiratory System
The Circulatory System
The Skeletal System

Organs

Organs are a group of tissues in a living organism that have been adapted to perform a specific function.

Tissues

There are four main types of tissue. Muscle, nervous, connective and epithelial. All having a common function.

Epithelial Tissue

This type of tissue lines the outer surface of your organs and all the blood vessels within your body. There are 6 types; simple squamous epithelia, simple cuboidal epithelia, simple columnar epithelia, stratified squamous epithelia, stratified cuboidal epithelia and stratified columnar epithelia. Forming together to form sheets of tightly packed cells.

Epithelial tissues are important in protection, absorption, excretion and sensation, acting as barrier between the body and the outside (external) environment.

Connective Tissue

Connective tissues within the body are vast and varied. These can include ligaments, tendons, muscle fascia, adipose tissue (fat), blood, cartilage and bone. Connective tissue helps to support and protect, insulate and transport. The function and location of connective tissue is dependent on the need by the body. For example, when it needs to be protective it is hard and dense, when it is in blood vessels it needs to be expandable.

Muscle Tissue

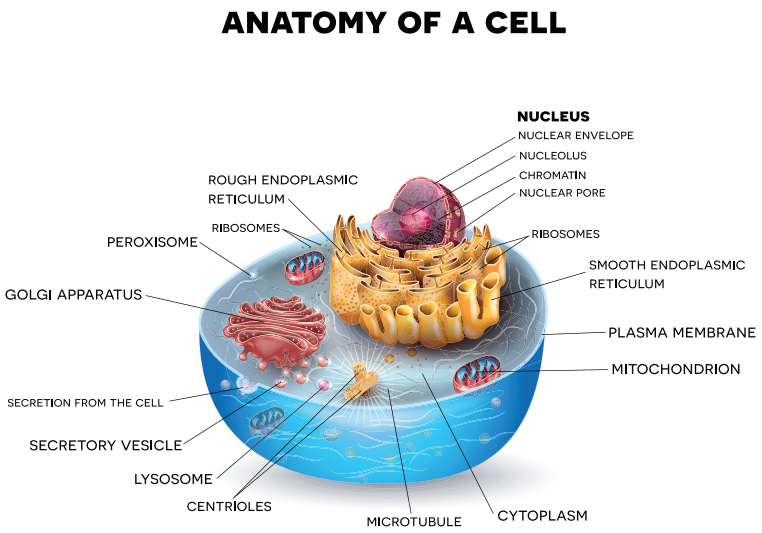
Muscle tissue contracts in order to enable and create movement.

Nervous Tissue

The nervous system is comprised of nervous tissue. The function of nervous tissue is to receive and transmit messages to enable the body to move and co-ordinate. This can be under conscious or unconscious control or voluntary and involuntary control.

Cells

These basic building blocks provide the starting point. A single cell named a Zygote is formed once the egg has been fertilised by sperm. The single cell then divides through a process called mitosis.
Although cells have many different functions they all have a very similar structure and each cell is surrounded by a cell membrane.



The cell membrane contains cytoplasm and organelles. The cytoplasm is approximately 90% water, with the remainder comprised of amino acids, sugars and other substances useful to the body. It fills a cell and enables it to keep a shape.

Organelles

Meaning little organ, *"organelle'* is a specialist part of a cell with a specific function. Organelles can differ from cell to cell, dependant on what is required of them.

Section 2: The Skeletal System

The skeletal system provides the underlying structure of the body, approximately one fifth of our total mass and performs vital functions such as blood production, protection and importantly, movement. Simply put without we would be just a pile of jelly of muscles and organs! We simply couldn't move either.

Structure of the Skeleton

The skeletal system is classified into two main structures:

Bone	Hard dense calcified tissue that forms the skeleton. There are 206 bones in an adult body connected by a series of joints.
Cartilage	A resilient, dense, fibrous rubber like connective tissue. There are three types in the body each with different roles. Hyaline, Elastic, Fibrocartilage.

Types of Cartilage

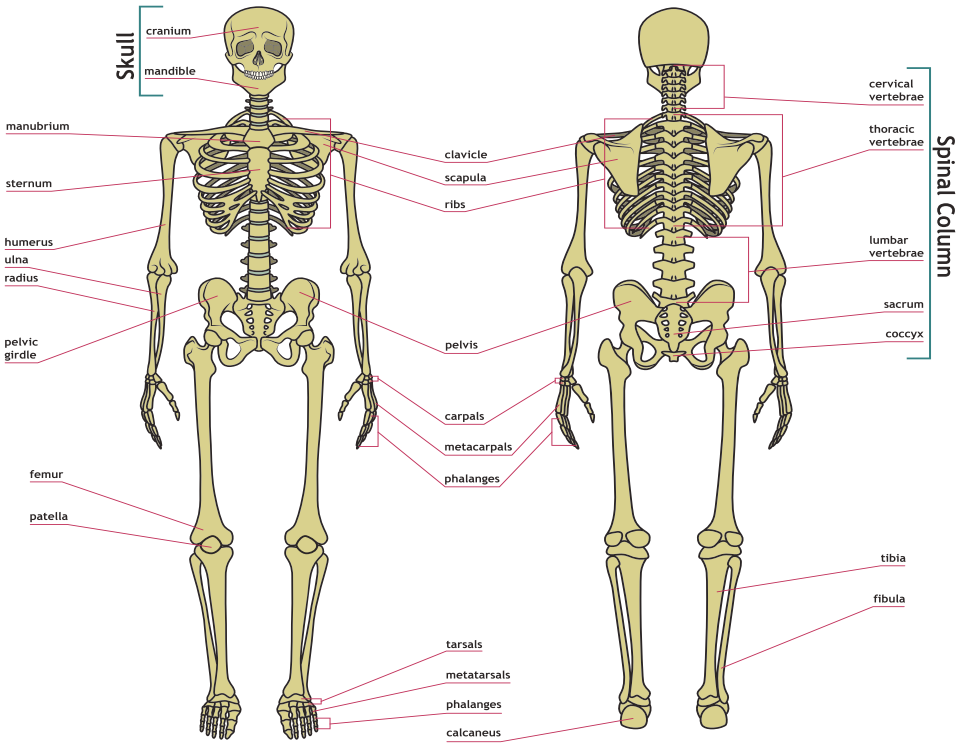
The three types of cartilage found in the human body are:

Hyaline Cartilage	**Found at the end of long bones that meet to form synovial joints.**
Elastic Cartilage	Has the ability to change and regain shape in response to tension, pressure and compression. It is present in the outer ear, Eustachian tube and epiglottis.
Fibrocartilage	The thickest and strongest of the different types of cartilage and acts as a shock absorber at cartilaginous joints.

The Skeleton is made up of two main sections:

Axial Skeleton:
Bones that form the main frame or axis.
Spine, Ribs, Skull.

Appendicular Skeleton:
Bone that attaches to the main frame.
Upper and lower limbs.
Shoulder and pelvic girdles.



Classification of Bones

Bones are classified according to their shape.

Classification	Description	Examples
Long Bones	Greater in length than in width. Consist of main shaft (Diaphysis) and two epiphysis (ends). Act as levers during movement. Contain mainly compact bone.	Humerus, femur, fibula, tibia, ulna, radius, metacarpals, metatarsals and phalanges.
Short Bones	Shaped roughly like a cube. Mostly cancellous bone. Located in the hands and feet.	Carpals and tarsals.
Flat Bones	Layer of cancellous bone between two layers of compact bone. Provide protection and large areas for muscle attachment.	Scapula, Cranial, Costals, Sternum, Ilium.
Irregular Bones	Vary in shape and structure.	Vertebrae and Calcaneus (heel bone).
Sesamoid	Embedded in tendons where friction and tension occur. Offer leverage and protection.	Patella, hands, feet.

Functions of Skeletal System

Shape	The Skeletal System gives the body its shape.
Protection	The skeletal System protects vital internal organs.
Attachment	Muscles, Ligaments and Tendons have attachments to create stability and movement.
Movement	Muscles pull on bones to create movement.
Production	Some bones produce white and red blood cells.
Storage	Bones store minerals such as calcium and phosphorus supporting growth.

Life and the Skeleton

The size and basic structure/shape of any individual's skeleton is something they are born with. However, its final shape and condition is hugely influenced by the 'lifestyle' we lead. Environmental factors, such as the loads we place upon it (lifting etc) and the nutrients we take in can impact growth and repair.

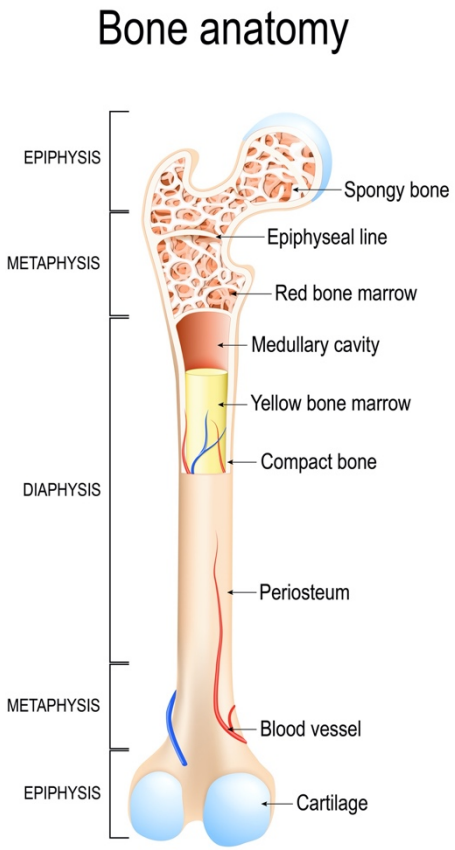
Bone Formation - Ossification

Most of the skeleton begins as cartilage, very strong fibres of collagen which are gradually replaced by compact or cancellous bone. This can be living or non-living material in a human being, both of which contribute to the evolving cycle of bone formation. A number of cells play important roles in this process. Ossification is the process in which bones of the skeleton are formed.
There are three processes involved in ossification which are:

Osteoblasts	Are the bone builders and form new bone.
Osteoclasts	Are the cells that remove old bone by making and secreting digestive enzymes that break up and dissolve old bone tissue.
Osteocytes	Are formed from old osteoblasts that have remained present and are involved in bone remodelling.

The constant activity of osteoblasts and osteoclasts, with the addition of minerals and salts, is the process by which new bone is produced. The blood aids the process by depositing these minerals into the bone via osteoblasts. In contrast, osteoclasts occupy small depressions which have been created on the bone surface by enzymes. They dissolve collagen and minerals which are then released back into the bloodstream.

Calcium compounds must be present for ossification to take place, and ossification is complete between the ages of 18 and 30. The growth and lengthening of long bones continues throughout this time. Lengthening or elongation is achieved by the expansion of epiphyseal plates at each end of the diaphysis.
These plates expand allowing new cells to form and increase the length of the shaft at both ends. The process stops when the thickness of the 14 epiphyseal plates decreases which occurs at different rates for different bones. Stresses of physical activity contribute to bone strength.



Epiphysis: The rounded end of the long bone containing spongy bone.

Diaphysis: The tubular shaft that runs between the proximal and distal ends of the bone.

Epiphyseal Line / Plate: Growth plates that allow for increase in length until adult hood.

Hyaline Cartilage: Covers both ends of the bone attached to other bones through a joint.

Periosteum: A tough fibrous sheath that covers the whole of the bone.

Compact bone: Solid bone that assists bones in withstanding pressure placed upon it through weight bearing exercises.

Spongy bone: Spongey bone tissue containing red bone marrow.

Medullary Cavity: Hollow tube that runs down the centre of the bone.

Yellow bone marrow: Storage of fat.

Red bone marrow: Production of blood cells.

Stages of Bone Growth

Foetal Stage

- Majority of the bone is made up of cartlige, a tough and flexible tissue. As the foetus grows this cartlige is slowly replaced and ossification begins. Osteoblasts and ostecasts slowly begin to work by forming bone. By the time the foetus is bone many bones have at least been partly formed.

Birth to Adulthood

- Long bones continue to lengthen through out this period from birth to teenager years. As we move towards the end of adolescences ther growth plates thicken and the grow process concludes. This differs with differing bones and within individuals, from around 18-25 this process ends. Bones are then strengthened by the stresses put against them.

Adulthood to later life

- Progressively calcium is lost from our skeletons and bones as we age. This begins to weaken our bones and their mass, leading to a risk off osteporosis rises. Responsible for hunched back and fractures in later years. Bones become hollower and less dense.

Factors Affecting Bone Formation

Bone health and development is influenced by a number of external factors and dictated by a person's lifestyle:

- Nutrition
- Hormonal excretions
- Exposure to sunlight (Vit D)
- Physical exercise

Nutrition is an important factor of bone health and growth. A diet of calcium rich foods vegetables and adequate protein intake are all important to the bone growth and avoiding issues in later life.

Bone health may be influenced by many factors from maternal nutrition, through toddler and pre-school years, with calcium intake playing an important role. Calcium can only reach its full bone building potential if the body has enough vitamin D. Calcium helps build and maintain bones while vitamin D helps the body absorb calcium effectively. We can get most of our vitamin D from exposure to sunlight.

Hormones are made in glands and travel around the body via the bloodstream. They are important in the balance between formation and reabsorption of bone. Physical activity causes new bone tissue to form. The stress placed on bones during weight-bearing activity has a direct influence on bone strength.

Effects of Exercise on the Skeletal System

With exercise comes many benefits to the skeletal system. Carried out correctly, prescribed exercise helps maintain our bones strength, density and health. However, if stresses placed upon it are too great or unbalanced then it can cause undue pain such as stress fractures. This is particularly true during adolescence, where growth plate fractures can occur if correct exercise is not prescribed, such as intensity.

Short Term	Long Term
• Increased flow of blood (o2) and nutrients to the joints, bones and muscles. • Synovial fluid secretion is increased, helping to lubricate the joints and lessen the effects of wear and tear. (Like the oil in a car).	• Increased strength and ligaments and tendons, increasing joint stability • Bone density is maintained • Posture is improved • Due to bone density being maintained the risk of Osteoporosis is reduced • Increased ROM, improving flexibility

Ligaments and Tendons

Ligaments are a tough white band of connective tissue that are able to withstand a large amounts of tension and attach bone to bone. Ligaments prevent excessive movement and maintain alignment to ensure smooth movement patterns.

Tendons are one of the strongest tissues in the body that attach muscle to bone transmitting a mechanical force produced by the muscle they are attached to muscle fibres at one end and part of the bone at the other end.

Joints

The point at which two or more bones meet is called a joint or articulation. There are three types of joint classifications that have different roles in the body Fibrous, Cartilaginous, Synovial.

Joint Name	Range of Movement	Examples
Synovial	Freely Moveable	Shoulders, Hips, Knees
Cartilaginous	Slightly Moveable	Vertebrae
Fibrous	Fixed and Immovable	The Skull

Injuries

Injuries to bone, muscle, ligaments, tendons, cartilage all heal at different rates due to their different characteristics.

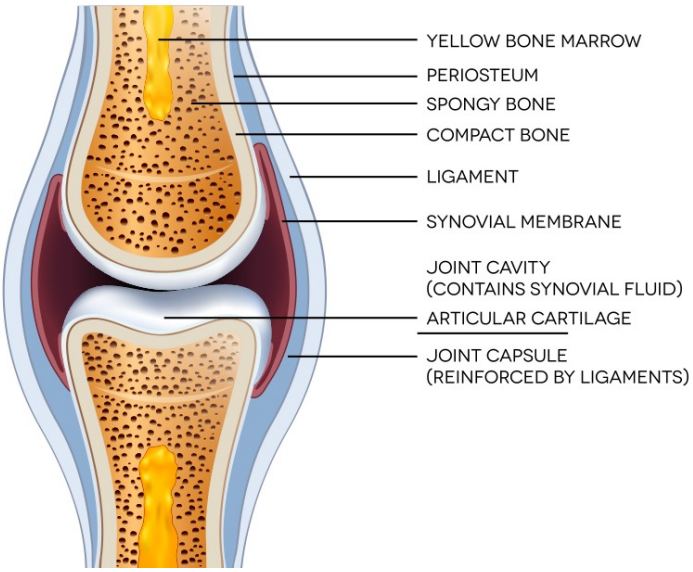
Blood supply is one of the major factors in healing injuries. Bone and muscles heal relatively quickly due to a good blood supply. Ligaments, tendons and cartilage have poor blood supply which limits their chances of recovery and often require surgery procedures to fix them.

Synovial Joints

Synovial joints are the most common joint. They are freely moveable, provide a wide range of large movements dependant on the type of synovial joint listed below.

The synovial joint is the site in which articulating surfaces of bones have contact with each other. The joint is surrounded by an articular capsule filled with synovial fluid allowing for smooth movements between the adjacent bones. The articulating surfaces of the bones are covered by a thin layer of articular cartilage. Ligaments support the joint by holding the bones together and resisting excess or abnormal joint motions.

SYNOVIAL JOINT



STRUCTURE:	DESCRIPTION:
Articular Cartilage / Hyaline	Covering each end of the bone helping to absorb shock and ensuring friction is prevented.
Ligaments	Connect bone to bone, helping to stabilise joints
Synovial Membrane	Stores and secretes synovial fluid.
Synovial fluid	Lubricates joints during movement
Joint Capsule	Holds all the properties of the synovial joint in place
Joint Cavity	The space inside the joint itself
Tendons	Muscle to bone and help transmit force.

JOINT TYPE	RANGE OF MOTION (ROM)	EXAMPLE
BALL & SOCKET	The greatest amount of movement allowed within the body. A vast array of movements that include flexion, extension, abduction and adduction, circumduction, and medial and lateral rotation.	Hip or Shoulder
HINGE	Bones can widen and shorten angle between the two articulating bones. Allowing flexion and extension, as exampled at the elbow joint.	Knee or Elbow
PIVOT	Allows rotation around an axis, as exampled C1 and C2.	Neck
SADDLE	Very similar to ball and socket joint, just without the ability to rotate. A prime example found at the thumb.	Thumb
GLIDING	Allows a gliding motion, bones will slide past each other.	Shoulder Girdle
ELLIPSOID	Another very similar to ball and socket but allows a lot less movement.	Knuckles

With such a vast array of synovial joints, the body is able to move in many different planes and many different directions. Skeletal muscles will pull on bones to create movement within the joints. With all movements comes specific anatomical terminology.

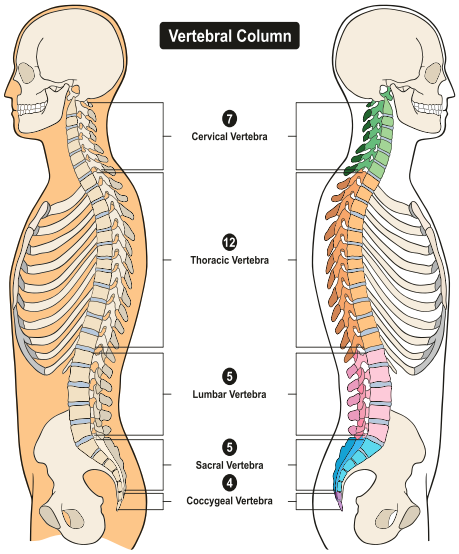
Joint Movements

A series of terminology used to describe movements listed below:

Anatomical Terminology of Movement Possible	Description of Movement
SPINE:	
Flexion	Decrease in the angle of the joint, bringing bone towards you
Extension	Increase in the angle, moving the bone away from the midline of the body
Lateral Flexion	Bend to the side
Rotation	Rotate about the long axis of the bone
SHOULDER AND HIP	
Flexion	Decrease in the angle of the joint, bringing bone towards you
Extension	Increase in the angle, moving the bone away from the midline of the body
Abduction	Move away from the mid line of the body
Adduction	Move towards the midline of the body
Medial Rotation	Movement around the longitudinal axis of the bone towards the centre of the body
Lateral Rotation	Movement around the longitudinal axis of the bone towards the centre of the body
Circumduction	Circular or cone-shaped movement
SHOULDER GIRDLE	
Elevation	Upward movement, with traps coming towards the ears
Depression	Downward movement of shoulders
Protraction	Forward movement of the shoulder Gridle, pulling shoulders forward
Retraction	Backward movement of shoulders.
KNEE	
Flexion	Decrease in the angle of the joint, bringing bone towards you
Extension	Increase in the angle, moving the bone away from the midline of the body
Medial Rotation	This is minimal - Movement around the longitudinal axis of the bone towards the centre of the body
Lateral Rotation	This is minimal - Movement around the longitudinal axis of the bone towards the centre of the body
ANKLE	
Dorsi Flexion	Move foot towards shin, bringing toes upward.
Plantar Flexion	Move foot away from shin, planting toes downward like in ballet.
Inversion	Move foot towards midline of body
Eversion	Move foot away from midline of the body
Elbow	
Flexion	Decrease in the angle of the joint, bringing bone towards you
Extension	Increase in the angle, moving the bone away from the midline of the body
Pronation	Hands facing downwards
Supination	Like holding a bowl of soup, hands facing upward
WRIST	
Flexion	Decrease in the angle of the joint, bringing bone towards you
Extension	Increase in the angle, moving the bone away from the midline of the body
Ulnar Deviation	Bend wrist towards little finger, going outwards away from the body
Radial Deviation	Bend wrist towards thumb, going inwards towards body

The Spine

The spine protects the spinal cord and has muscle attachments which facilitate movement and stability. The spine has 5 sections compromising of 33 irregular bones which are called vertebrae. There are four natural curves in an adult spine, two convex thoracic and sacral and two concave lumbar and cervical.



Cervical: 7 vertebrae that provide movements rotation, flexion and extension, lateral flexion and extension.

Thoracic: 12 vertebrae that provide same movements as the cervical vertebrae at less range of motion (ROM). The upper thoracic is limited to flexion and extension.

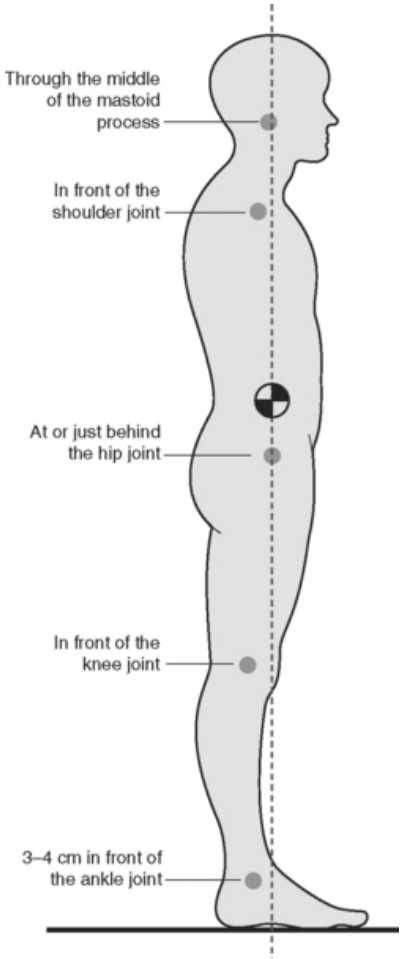
Lumbar: 5 vertebrae that offer very limited ROM of those of the cervical and thoracic vertebrae.

Sacral: 5 vertebrae and coccyx 4 vertebrae that are fused together and allow no movement.

Neutral Spine

Holding a neutral spine is a common term to help avoid back injuries reducing stress on the supporting structures and standing in a natural position that has all 3 curves of the spine cervical thoracic and lumbar in good alignment. Posture can be defined as the attitude or position of the body (Thomas, 1997) and according to Martin (2002), should fulfil three functions:

1. It must maintain the alignment of the body's segments in any position: supine, prone, sitting, quadruped, and standing
2. It must anticipate change to allow engagement in voluntary, goal-directed movements such as reaching and stepping
3. It must react to unexpected perturbations or disturbances in balance



The neutral spine position often referred to describes the ideal position to minimise stress on the vertebrae and the associated ligaments. In turn, achieving this posture during physical activity will help to reduce the risks of back pain and optimum performance can be maintained. It will also allow musculature to perform in a balanced way and maintain this optimal spinal curvature.

"Good posture is the state of muscular and skeletal balance that protects the supporting structures of the body against injury or progressive deformity irrespective of the attitude (e.g. erect, lying, squatting, stooping) in which these structures are working or resting"
(Posture Committee of the American Academy of Orthopaedic Surgeons,1947).

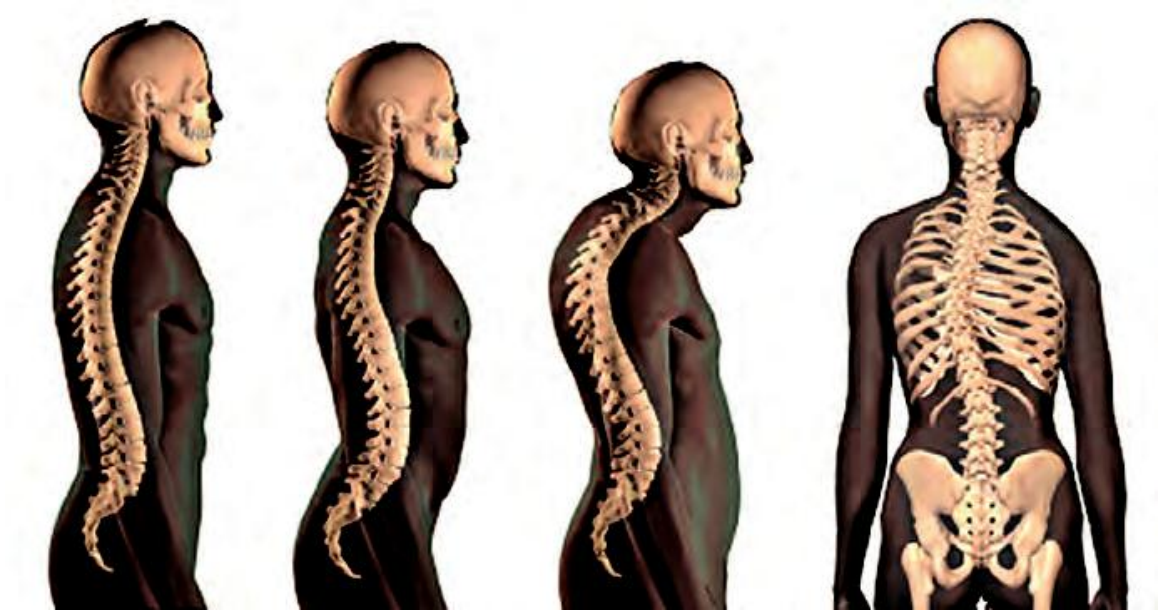
Stabilising Ligaments

Ligaments provide some passive support (weaker than muscles) and prevent unwanted movement of the spine.
There are 4 main ligaments that run the length of the spine:

Anterior Longitudinal Ligament	Posterior Longitudinal Ligament	Interspinous Ligaments	Intertransverse Ligaments
•Connects each vertebral body together •Runs anteriorly along the front of the spine •Prevents excess extension of the spin	•Runs along the back of the spine underneath the spinous processes •Connected to the vertebral bodies of each segment •Prevents excess flexion of the spine	•Connect the spinous processes to the one immediately above or below •Work with the posterior longitudinal ligament to prevent excess flexion of the spine	•Connect each transverse process to the one immediately above or below •Run on both the left and right side of the spine •Prevent excess lateral flexion

Postural Deviations

A deviation from optimal spinal posture is quite common, especially within today's lifestyle choices and positions. Due to the way clients sit, interact on digital devices such as mobiles and tablets, and everyday strains and pressures, some changes in their posture and spinal deviations can be caused over long periods of time. Some deviations may also be due to genetics.



Neutral Lordosis Kyphosis Scoliosis

Kyphosis

Kyphosis is excessive curvature of the cervical region giving a hunchback type appearance caused by tightened and shortened muscles in the chest area and the muscles of the upper back are lengthened.
Those who are in a seated position for most of the day tend to adopt the following posture:

- Thoracic kyphosis with lengthened middle trapezius and rhomboids

- Protracted shoulders and shortened pectorals
- Extended cervical spine and shortened upper trapezius
- Posteriorly tilted pelvis and lumbar flexion

Individuals with postural dysfunctions tend to show limited thoracic rotation and extension – restricting the movement of the arms above the head

Lordosis and Hyperlordosis

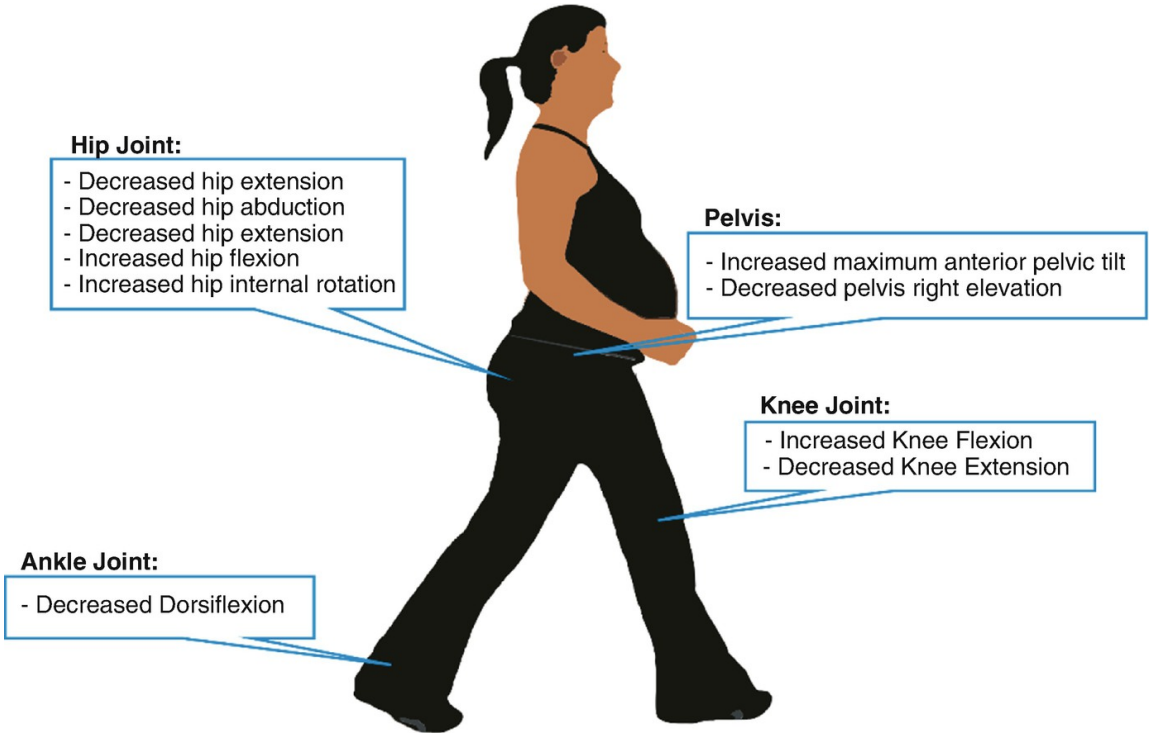
Lordosis is excessive spine curvature of the lower back creating a C shaped curve. This can be caused by a number of issues including obesity, poor posture, weak abdominal muscles and lengthened erector spinae. Abdominal obesity shifts the centre of gravity forwards which leads to an increased chance of postural deviations such as an excessive lordotic posture. As a result loading patterns become faulty and increase the strain on the spine and surrounding joint structures. Those with hyperlordosis (excessive lumbar lordosis) often have a reduced range of lumbar flexion and restricted hip mobility which increases the risk of disc protrusion or herniation and sciatica.

Scoliosis

Scoliosis is a sideways lateral curve in the spine and can affect people of any age however most common during teenage years.
Core stability and corrective exercises can be incorporated into an exercise programmes to improve posture. Often it is to strengthen overstretched muscles that are causing tightness in another area.

The Spine during Pregnancy

During pregnancy, it is not uncommon for the client's posture to change. Pregnancy can enhance the curvature of the lower spine, shifting the centre of gravity backwards to compensate for the extra weight at the front. Abdominal muscles lengthen and weaken together with the extra weight of the baby can change the position of the pelvis.
Postural abnormality caused by pregnancy, labour and breastfeeding can be both temporary and permanent. Deviations such as kyphosis can occur post birth from holding and cradling a baby.



Movement of the Spine

Due to the structure and the number of bones within each area of the spine, there is potential for differing types of movement within it. The cervical and lumbar regions with concave curves give the greatest range of movement to the body.

The cervical region of the spine is capable of flexion, extension, lateral flexion and rotation. It has the greatest amount of lateral flexion and rotation of any region of the spine.
The skull sits on top of the atlas bone enabling flexion, extension and lateral flexion. The atlas and the axis bones of the cervical vertebrae form a pivot joint, allowing rotation.

The thoracic spine is less mobile and thus more stable than the cervical. It also allows flexion, extension, lateral flexion and rotation.

The upper thoracic vertebrae are limited in their flexion and extension. The lower thoracic vertebrae allow a much greater range. The combined thoracic vertebrae are capable of significant amounts of rotation.

The lumbar spine region allows some flexion with a greater capacity for extension. Rotation and lateral flexion are more limited than the other regions of the spine such as the cervical and thoracic.

The vertebrae (bones) of the sacrum and coccyx are fused together therefore the region of the sacral spine does not move.

Postural Dysfunction and its Effect on Movement Efficiency

Postural deviations cause core muscular dysfunction around the core. This affects an individual's ability to hold good form and a neutral spine during exercise and activity.
Posture can be affected by:

- Employment (desk jobs can affect the length tension relationships of muscles)
- Bodyweight (e.g. being overweight)
- Height
- Lifestyle
- Activity habits
- Degenerative disease/ previous injury

Section 3: The Neuromuscular System

All movement is based around the skeletal system, achieved by muscle tissue pulling on bone to produce motion at mobile joints. Knowledge of its structure and function will allow a greater understanding of movement and exercise. This section will discuss the various joints, the exact origin and insertion points of specific muscles and the angles that fibres cross joints to determine the movement at synovial joints. It will investigate how the muscular and skeletal systems generate movement during exercise.

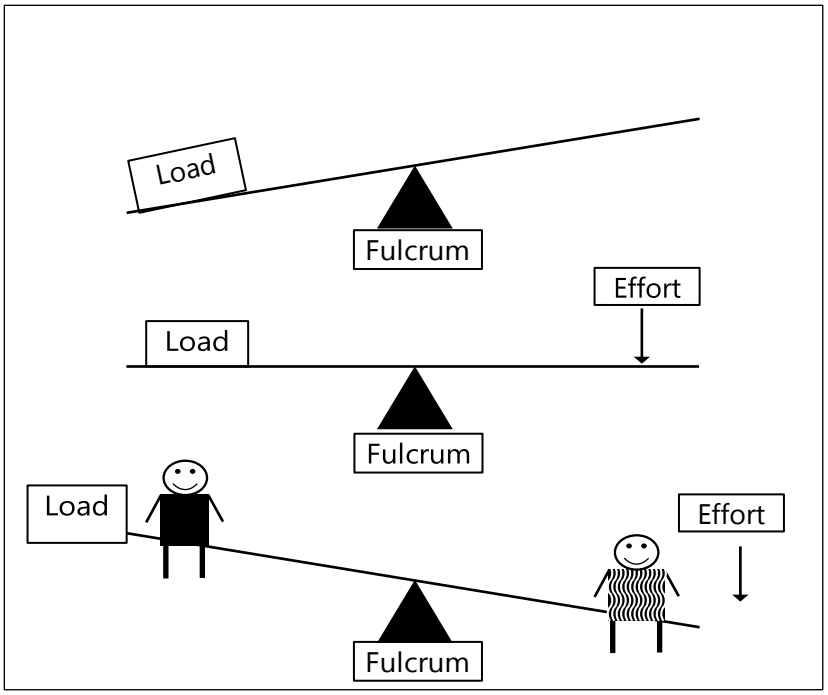
Functional Kinesiology

The Lever System

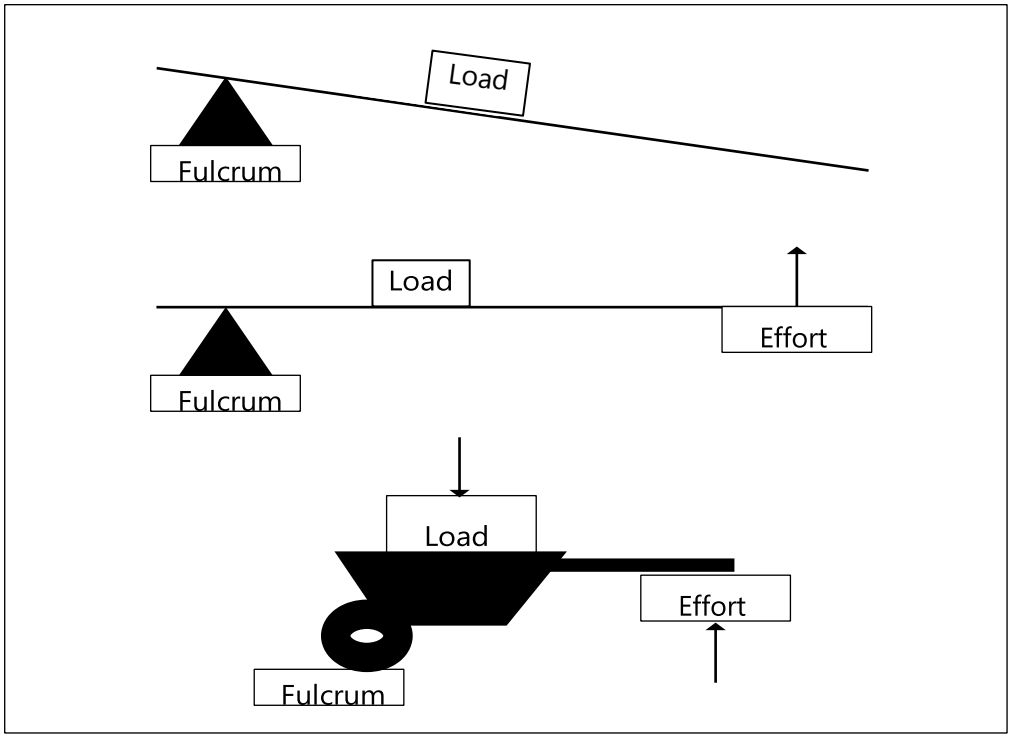
By understanding movement we are able to make better judgments regarding choice of exercises and their execution.
Humans move or pick up objects via a basic system of levers. A lever is a simple machine consisting of a rigid rod that moves or pivots around a fixed point (fulcrum). If we vary the position of the fulcrum, the load or the effort; different combinations of speed, range of movement and force can be generated.

Levers take on three basic forms.

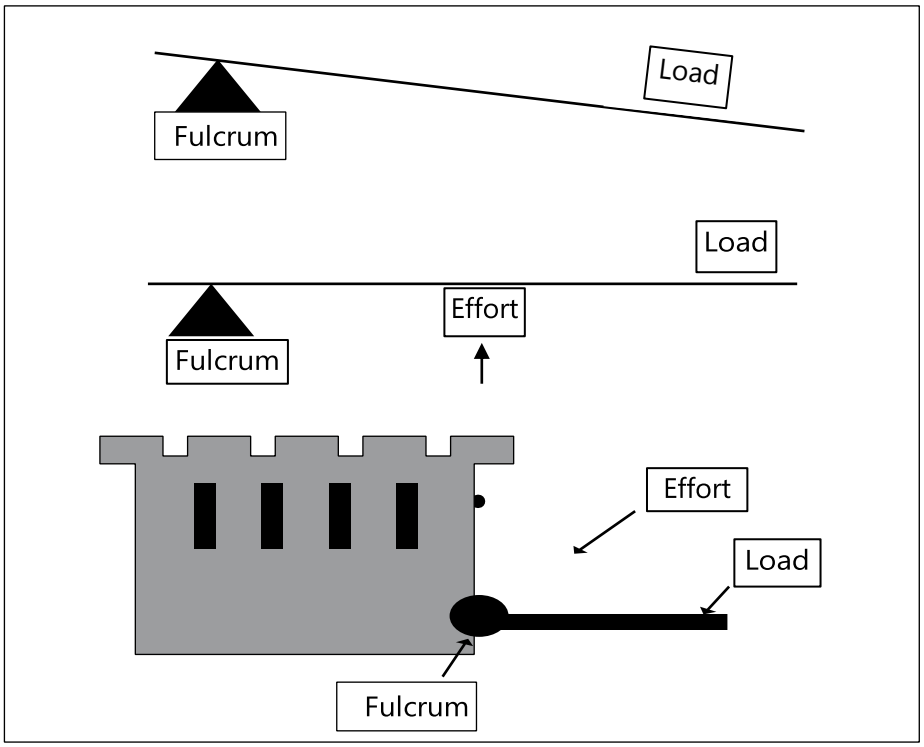
1st class levers: the best example of this kind of lever is a seesaw. The fulcrum is between the effort and the load. Moving the fulcrum closer to, or further away from the load; speed, range of movement and force generated will vary. Although simple, this form of lever is not common in the body. Examples include the triceps extending the forearm; gastrocnemius and soleus plantar flexing the foot when it is off the ground.



2nd class levers: the best example of this type of lever is a wheelbarrow. The fulcrum and the effort are at opposite ends with load placed in between. This arrangement produces plenty of force, but like 1st class levers there are relatively few examples in the body.



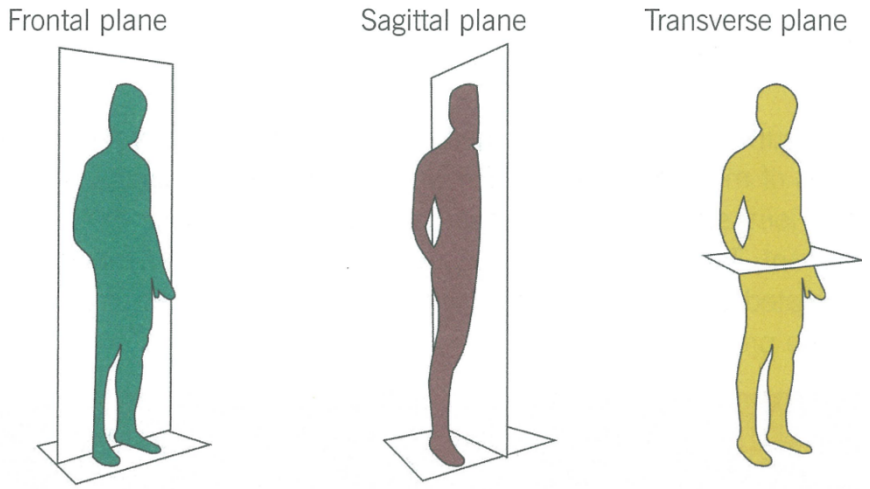
3rd class levers: the most common form of lever in the body. The fulcrum and the load are at opposite ends with the effort placed in between. This is similar to a drawer bridge and generally produces less force than the other forms of lever but provides a much greater range of movement and speed.



Anatomical Planes

Planes are imaginary flat surfaces along which movement can occur or that represent anatomical cross-sections. There are three basic planes; frontal (coronal), sagittal and transverse. It is important to point out that human movement occurs simultaneously in multiple planes.

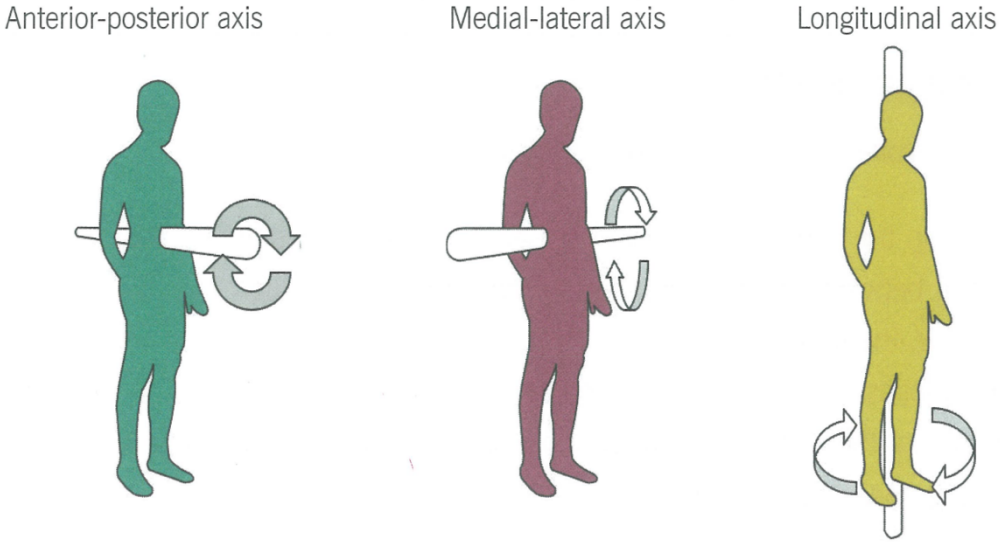
Frontal	•A vertical plane that divides the body into anterior and posterior
Sagittal	•A vertical plane that divides the body into left and right parts
Transverse	•A horizontal cross-section through the body separating the upper body from the lower body



Axes of Movement

An axis is a line that passes through a plane, about which movement (rotation) occurs.

Frontal horizontal axis (medial - lateral)	•Passes through the sagittal plane: rotation would occur in the sagittal plane
Vertical axis (longitudinal)	•Passes through the transverse plane: rotation would occur in the transverse plane
Sagittal horizontal axis (anterior – posterior)	•Passes through the frontal plane: rotation would occur in the frontal plane



The following table provides examples of key joint movements, the planes and axes of movement.

Main Joint Actions	Dominant Plane of Movement	Dominant Axes of Movement
Flexion Extension Hyper-extension Dorsi-flexion Plantar-flexion	Sagittal plane	Medial-lateral axis
Abduction Adduction Inversion Eversion Lateral-flexion	Frontal plane	Anterior-posterior axis
External rotation Internal rotation Supination Pronation Rotation Horizontal flexion Horizontal extension	Transverse plane	Longitudinal axis

Joint Structure and Movement

Joint types, muscle configurations and sequences of muscle actions are responsible for the range and capability of human movement. It is important to understand the movement available at joints and their limitations to ensure the safety of exercise.

At a basic level it is important to remember the types of joints:

Fibrous:	Immoveable with interlocking bones e.g. the plates in the skull
Cartilaginous:	Slightly moveable bones connected by ligaments e.g. the vertebrae
Synovial:	Freely moveable and the most common type of joint in the human body e.g. hip, knee, ankle, shoulder, elbow

And at a deeper level, the synovial joints:

Gliding Joints:	The mid-carpal and mid-tarsal bones of the wrist and ankle
Pivot Joints:	Between the atlas and axis of the cervical vertebrae
Saddle Joints:	The thumb
Ball and Socket joints:	The hip and shoulder
Hinge Joints:	The elbow and knee
Ellipsoid Joints:	The knuckles between the phalangeal bones of the fingers and toes

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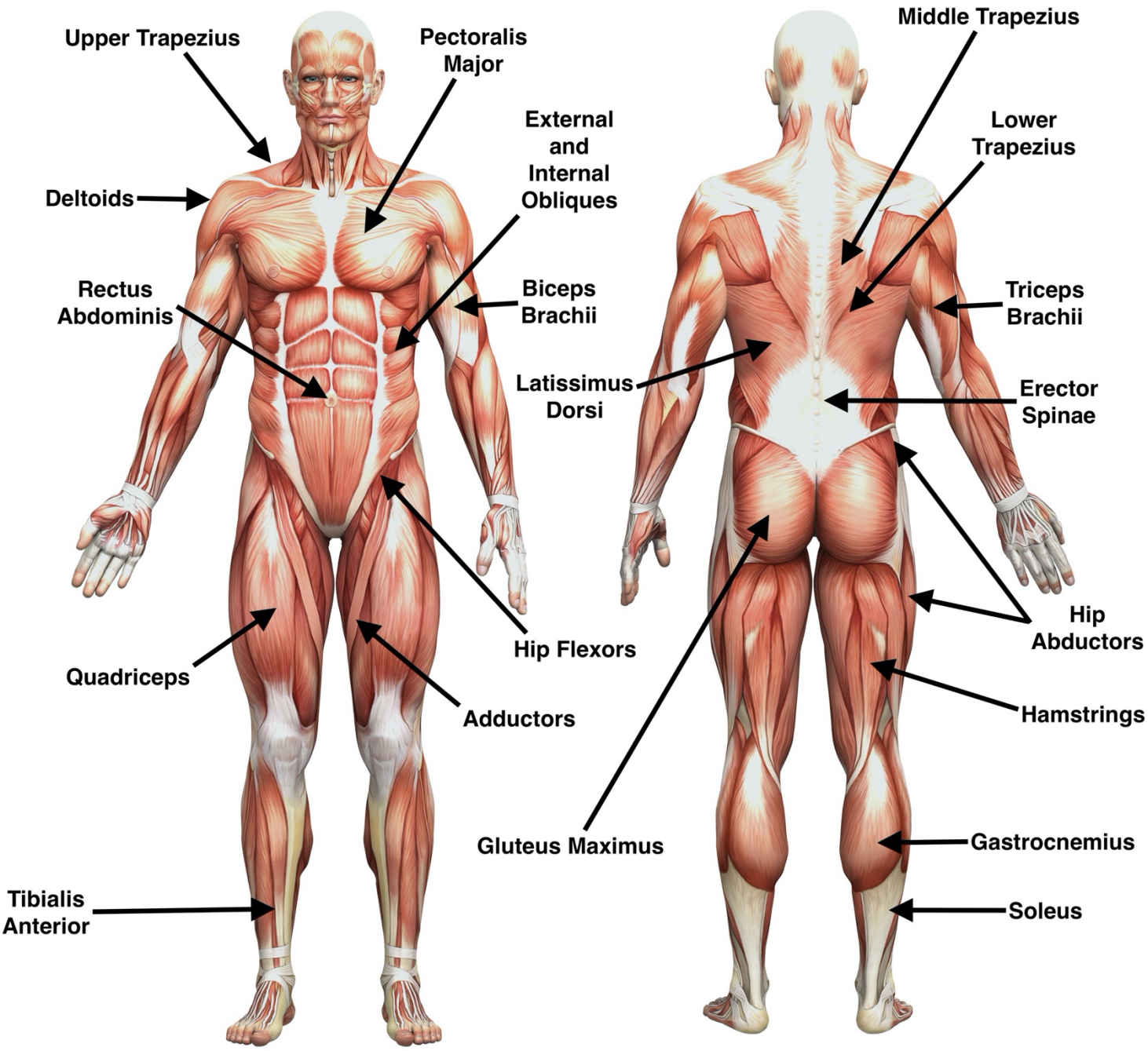
The following table provides an overview of the main synovial joints in the body, the movement available and the planes and axes they move in and rotate about.

Joint	Actions	Plane of Movement	Axis of Movement
Shoulder	Flexion – extension Abduction – adduction Internal – external rotation	Sagittal Frontal Transverse	Medial-lateral Anterior-posterior Longitudinal
Elbow	Flexion – extension	Sagittal	Medial-lateral
Spine	Flexion – extension Lateral flexion Rotation	Sagittal Frontal Transverse	Medial-lateral Anterior-posterior Longitudinal
Hip	Flexion – extension Abduction – adduction Internal – external rotation	Sagittal Frontal Transverse	Medial-lateral Anterior-posterior Longitudinal
Knee	Flexion – extension	Sagittal	Medial-lateral
Ankle	Plantarflexion – dorsiflexion	Sagittal	Medial-lateral

Location of Skeletal Muscles



The Shoulder Joint

Formed by the articulation of the scapula and humerus (shallow ball and socket joint), the shoulder joint allows a wide range of movement including flexion, extension, abduction, adduction, internal and external rotation and circumduction. The majority of movement at this joint is provided by the pectoralis major, latissimus dorsi and deltoids. The shoulder joint may often be referred to as the glenohumeral joint as the head of the humerus articulates with the glenoid cavity (fossa)

Pectoralis Major

Deltoid

Latissimus dorsi

Deep Musculature of the Shoulder

Underneath the joint is a more subtle arrangement of musculature. Each originates on the scapula and inserts on the upper humerus and plays a key role in stabilising the shoulder joint and controlling movement. They are often referred to as the rotator cuff. Having stability, integrity and coordinated function reduces the potential risk of injury to these muscles and at this joint. The subscapularis is the largest and strongest rotator cuff muscle, essential in overhead sports.

Teres Minor	Runs laterally from the scapula to the humerus to aid with adduction and external rotation
Supraspinatus	Runs superiorly from the scapula to the top of the humerus to aid shoulder abduction
Infraspinatus	Runs laterally from the scapula (higher than the teres minor) to the humerus to aid horizontal extension, external rotation and adduction
Subscapularis	Runs from the underneath of the scapular to the front of the humerus to aid internal rotation and adduction

Teres Minor – Abduction and lateral rotation

Supraspinatus – Shoulder abduction

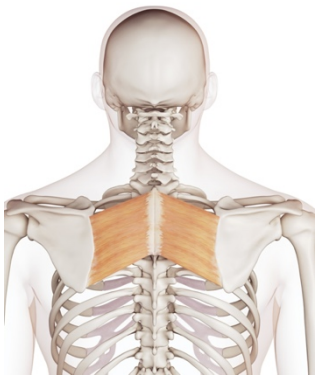
Infraspinatus – Horizontal extension, lateral rotation and abduction

Subscapularis – Internal rotation and adduction

The Shoulder Girdle

The shoulder girdle is comprised of the scapula and the clavicle. They move in coordination with the shoulder joint to allow complex movements in the upper limbs.

Posterior Muscles of the Shoulder Girdle



Rhomboid Major

Rhomboid Minor

Levator Scapula

Trapezius

These muscles allow for various combinations of elevation (shrugging the shoulders), retraction (shoulders back, chest out) and depression (shoulders dropped) to occur

Anterior Muscles of the Shoulder Girdle

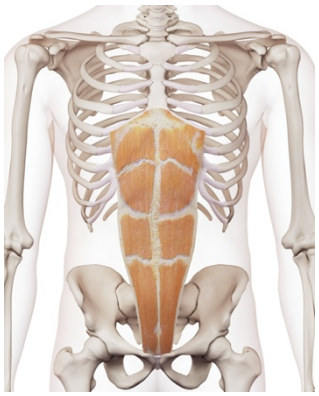
Serratus Anterior

Pectoralis Minor

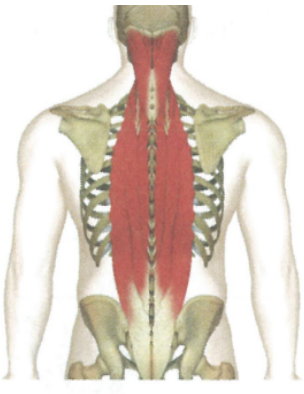
The pectoralis minor and serratus anterior originate at the costal bones and insert on the anterior surfaces of the scapula. The anterior-inferior alignment allows them to both to protract and depress the shoulder girdle. When used with the appropriate shoulder joint action they can assist in pushing movements such as press ups.

The Vertebral Column

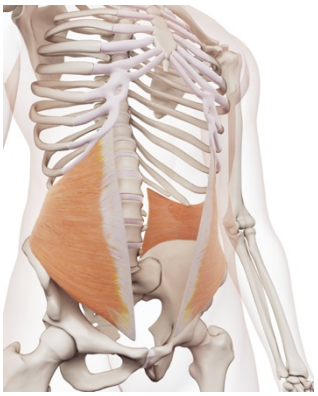
A series of irregular vertebral bones linked by cartilaginous, slightly moveable joints, separated by intervertebral discs. The muscles below control spinal movement causing flexion, extension and rotation. Working unilaterally they pull the spine into lateral flexion



Rectus Abdominis



Erector Spinae



Internal Obliques

External Obliques

Two important muscles of the posterior are the multifidus and quadratus lumborum.

Multifidus	Runs from the sacrum to the cervical spine. It links small sections of the vertebrae together. It aids the control of flexion and rotation of the vertebral column. Considered a key element of the core musculature
Quadratus Lumborum	Runs from the iliac crest to the lumbar vertebrae and lower ribs. It aids to laterally flex and extend the spine. It also assists in laterally tilting the pelvis

The Hip Joint

A ball and socket joint, formed by the articulation of the acetabulum of the pelvis with the head of the femur. Subjected to the forces from the strong muscles of the leg and hip, it allows us to walk, run and jump.

Designed to be a stable and weight bearing joint, musculature either flexes (iliacus, psoas, rectus femoris) or extends (gluteus maximus and hamstrings), abducts (piriformis and tensor fascia latae; gluteus medius or minimus) or adducts (adductor longus, brevis, or magnus; pectineus and gracilis).

The hip joint opts for stability over mobility, whilst the opposite is true of the shoulder joint, therefore (despite being the same 'type' of joint) the shoulder is more prone to dislocation than the hip

The Knee Joint

A synovial hinge joint that joins the thigh bone (femur) to the shin bone (tibia), the knee is one of the most complex joints which plays an essential role in supporting the body's weight.
During normal activity the knee can tolerate considerable force and stress, however it often lacks the necessary support and is more susceptible to damage and injury from rotational forces.

The primary movements at the knee are flexion and extension which is associated with muscles found on the anterior or posterior of the hip and femur.
Whilst in a flexed position a small amount of internal rotation is possible.

The Quadriceps

Vastus intermedius

Vastus lateralis

Vastus medialis

Rectus femoris

Although the 4 quadricep muscles originate from different places they all insert onto the tibia via the patella tendon.
The rectus femoris is the only muscle to pass both the hip and knee joint so therefore enables hip flexion and knee extension.

The Hamstrings

Biceps femoris

Semimembranosus

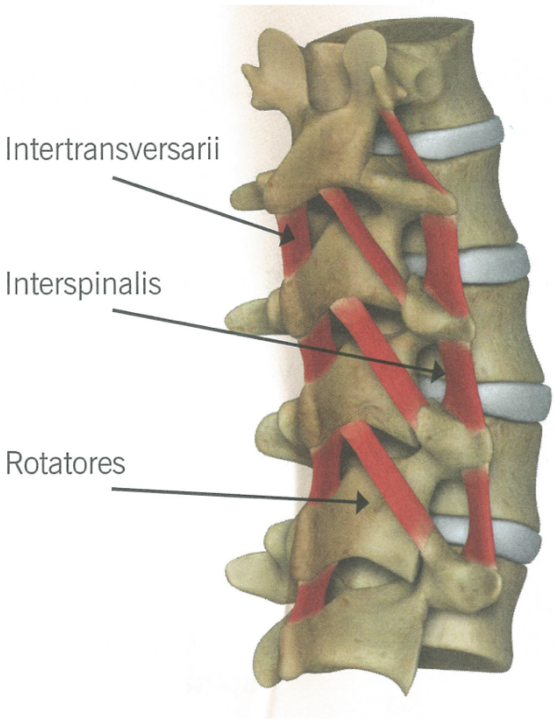
Semitendinosus

The three muscles of the posterior leg all cross the knee and the hip. They are responsible for knee flexion and hip extension.
The biceps femoris has 2 heads – one long and one short. The short head only cross the knee so cause knee flexion but have no part in hip extension

The Muscles of the Spine

Without the supporting musculature the human spine is unstable. Muscles can be grouped into 3 distinct layers – deep, middle and outer; and the coordination of these muscles determines the level of safe and effective core function

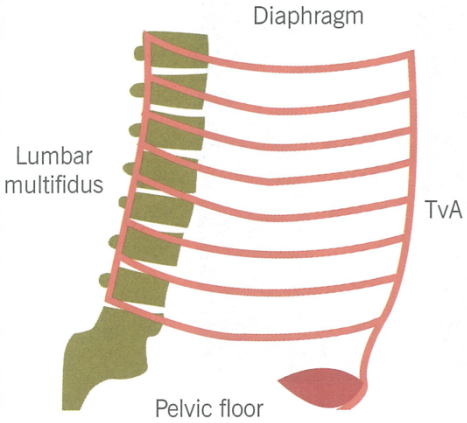
The Deep Muscles of the Spine



Intertransversarii	Attach between the transverse processes of the spine Help to bring about lateral flexion and control smaller movements between the vertebrae
Interspinalis	Attach between the spinous processes of the spine Help to bring about extension of the spinal sections whilst controlling smaller movements between the vertebrae
Rotatores	Attach from the spinous process of one vertebrae to the transverse process of the vertebrae immediately below Help to bring about rotation between spinal sections and control the smaller movements between the vertebrae

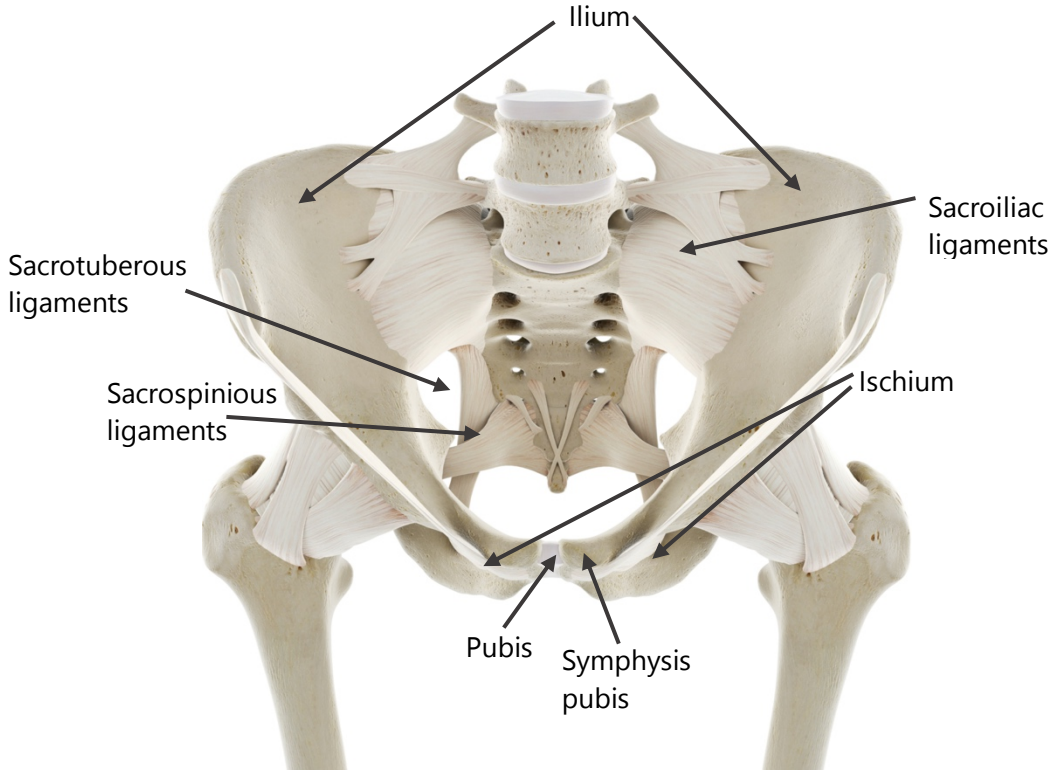
The Middle Muscle Layer (Inner Unit)

These muscles help to provide stability and create intra-abdominal pressure to stabilise the spine during movement. It includes the transversus abdominis (TVA), lumbar multifidus, diaphragm and pelvic floor. The muscles contract together to form a cylinder to stabilise the spine so the arms and legs can function optimally. Research has shown that before movement of the extremities the inner unit is activated. Faulty inner unit recruitment is likely to result in lower back pain



Transversus Abdominis	Multifidus	Diaphragm	Pelvic Floor
•Wraps around the body attaching to the lower ribs and pelvis •Draws the waist in and compresses the abdominal contents •Increases intra-abdominal pressure to stabilise the spine	•A series of smaller muscles that connects the spinous processes of the spine to the transverse processes 2 or 3 vertebrae below •Help to provide rotation and extension of the spine and hold the lumbar segments in an extended position	•Primary muscle that initiates breathing •Contracts downwards and helps create intra-abdominal pressure to help stabilise the spine along with all of the other muscles in the group	•Made up of several small muscles •Acts as a hammock at the base of the body to hold the organs •Contracts at the same time as the diaphragm and other core muscles to create intra-abdominal pressure and stabilise the spine

The Pelvic Girdle



Most of the main musculature for the hip and knee originates in the pelvic girdle. The pelvis forms a strong, bone ring that sits in between the base of the vertebral column and the head of the femur.
The 'pelvic girdle' is commonly referred to as a collective name for the 6 bones that form the pelvis and structures that connect it to the hip and sacrum. Normally, it is a symmetrical structure of 2 halves which are joined at the pubis and sacrum.
Each half has 3 separate bones:
The top flat half is called the ilium
The front middle section is the pubis
The bottom section is called the ischium

The left and right pubic bones are united by a cartilaginous joint known as the pubis symphysis

Pelvic Ligaments

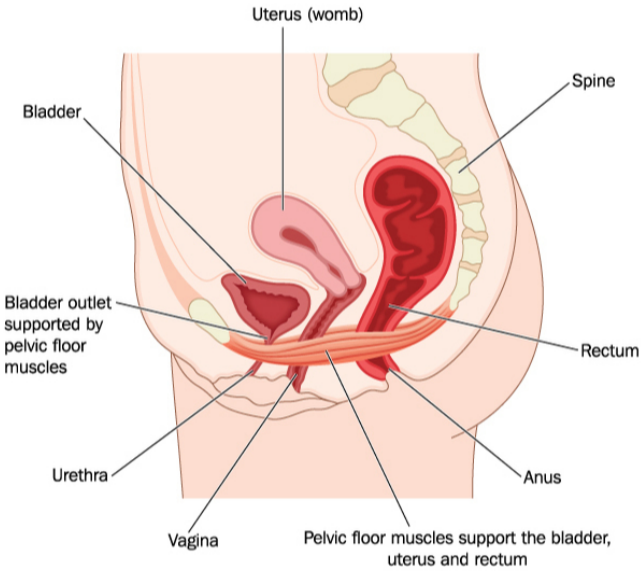
Ligaments connect the pelvic girdle and provide passive strength and rigidity

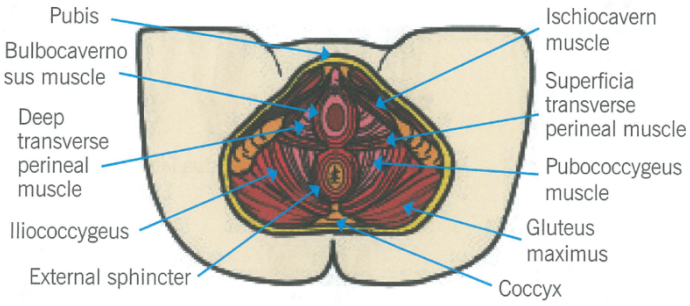
Sacroiliac ligaments	pass in front of and behind each sacroiliac joint
Symphysis pubis ligaments	are used to bridge spaces in the walls of the pelvis
Sacro-tuberous ligaments	extend from the sides of the sacrum to the ilium crossing the sciatic notches
Sacrospinous ligaments	pass from the sides of the sacrum to the ischial spines, extending across the greater sciatic notch

Pelvic Muscles

There are 35 different muscles in the pelvis with various functions. They support the internal organs, control lumbar spine movement, stabilise the pelvic position and generate gross physiological movement.
The primary muscles are:

- Iliopsoas
- Adductor complex
- Hamstrings
- Gluteal muscles
- Rectus femoris
- Tensor fascia latae
- Pelvic floor muscles
- Abdominals and obliques
- Quadratus Lumborum
- Piriformis





Joint Actions Caused by Specific Muscle Groups

Origins

- The fixed end of a muscle that is attached to a bone
- Described as the proximal attachment
- Muscles can have more than one origin

Insertions

- The end of a muscle attached to a bone that usually moves during contraction
- Described as the distal attachment
- Muscles usually have one single attachment

When muscles contract and shorten they pull on bones to create an action or movement. Efficient movement is dependent on the coordinated activity of whole groups of muscles and involves a variety of muscle actions

Agonist/ Prime mover	The muscle that causes the intended action
Antagonist	The opposing muscle to the agonist
Synergist	The muscle that assists or modifies the movement of the prime mover
Fixator	The muscle that stabilises the part of the body that remains fixed

Muscle		Location	Origin	Insertion	Action
Deltoid		Shoulder	Clavicle, acromion and spine of scapula	Humerus	Anterior: Abduct shoulder Horizontally adduct medially rotate Posterior: Abduct shoulder Horizontally adduct Laterally rotate
Rotator Cuff	Teres minor	Shoulder	Lateral boarder of scapula	Greater tubercle of humerus	Adduct and laterally rotate shoulder
	Subscapularis		Anterior scapula (subscapular fossa of scapula)	Greater tubercle of humerus	Medially rotate and stabilise humerus
	Infraspinatus		(scapula) Infraspinous fossa scapula	Greater tubercle of humerus	Laterally rotate and adduct shoulder
	Subscapularis		Scapula (supraspinatus fossa of scapula)	Greater tubercle of humerus	Adduct and stabilise humerus
Teres major		Shoulder	Inferior angle of scapula	Humerus	Extension, adduction and internal rotation of the shoulder joint
Levator scapula		Upper back and neck	C1-4 vertebrae	Medial boarder of scapula	Elevate scapula unilaterally laterally flex neck Bilaterally extend neck
Tricep brachii		Back of the upper arm	Long head:scapula Medial head: humerus Lateral head: humerus	Ulna	Extend elbow Long head: adduct and extend shoulder
Bicep brachii		Front of the upper arm	Scapula	Tuberosity of radius	Flex elbow Supinate forearm Flex shoulder
Latissimus dorsi			Scapula, spinous processes, ribs, thoracolumbar spine, iliac crest	Humerus	Adduction shoulder Extend shoulder Medially rotate shoulder

Muscle		Location	Origin	Insertion	Action
Trapezius		Upper back	Occipital spinous process C7-T12	Clavicle, spine of scapula and acromion	Bilaterally extend head and neck Unilaterally- lateral flex neck Rotate the head in opposite side Depress and upwardly rotate
Rhomboids	Major	Mid back	Medial boarder of scapula	spinous process T2-T5	Adduct scapula
	Minor		Upper boarder	spinous process C7- T1	Elevate and retract shoulders
Pectorals major		Chest	Clavicle and sternum	Greater tubercle humerus	Medially rotate shoulder Flex and horizontally adduct
Pectoral minor		Chest	3rd, 4th 5th rib	Medial surface of the scapula	Depress the scapula Abduct the scapula
Serratus anterior		Side of the torso	Upper eight or nine ribs	Anterior surface of the medial boarder of the scapula	Abduct shoulder depress the scapula
Erector spinae		Either side of the spine	Sacrum, ilium, ribs and vertebrae	Ribs, vertebrae and base of the skull	Extension and lateral flexion of the spine
Iliocostalis (3 erector spinae muscles)		Either side of the spine	Sacrum, ilium and posterior surfaces of ribs 1-12	Posterior surface of ribs 1-12 and transverse processes of the cervical vertebrae	Lateral flexion and extension of the spine
Longissimus (3 erector spinae muscles)		Either side of the spine	Transverse processes of the lumbar and thoracic vertebrae	Ribs and transverse processes of the thoracic and cervical vertebrae and mastoid process	Lateral flexion and extension of the spine
Spinalis (3 erector spinae muscles)		Either side of the spine	Spinous processes of the upper lumbar and thoracic vertebrae	Spinous processes of the upper thoracic and cervical vertebrae	Lateral flexion and extension of the spine
Multifidus		Either side of the spine	Sacrum and transverse processes of lumbar, thoracic and cervical vertebrae	Spinous processes of 2nd-4th vertebrae above each origin	Extension and rotation of the spine
Quadratus Lumborum		Lower back	Posterior iliac crest	Last rib and transverse processes of 1st -4th lumbar vertebrae	Unilaterally – lateral flex spine Bilaterally- fix ribs during in and exhalation.
Rectus abdominis		Along the centre of the abdomen	Pubis	Cartilage of 5th-7th rib and base of the sternum	Flexion and lateral flexion of the spin and posteriorly tilts the pelvic

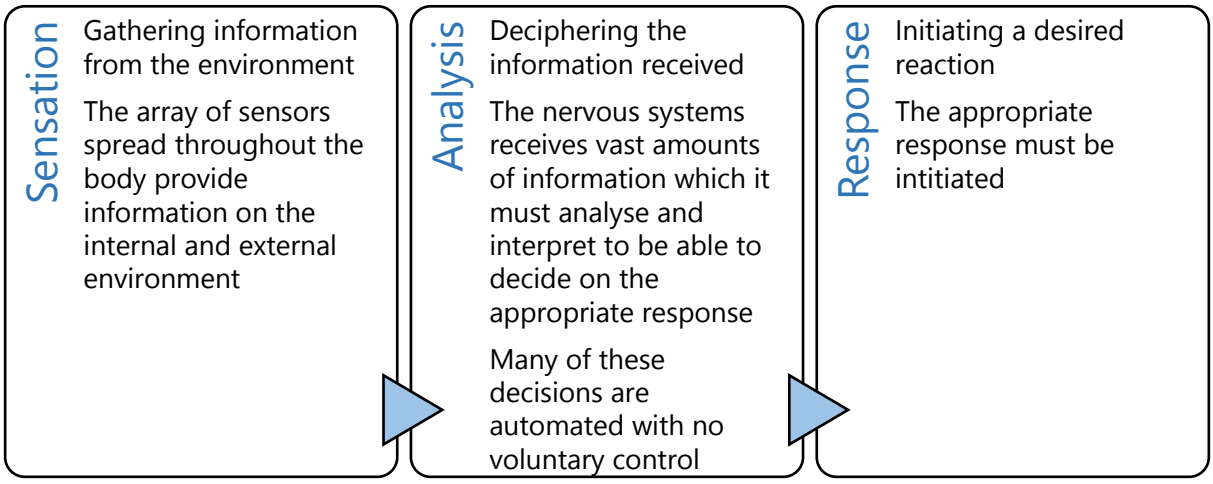
Muscle		Location	Origin	Insertion	Action
Internal obliques		Sides of the abdomen	Iliac crest and thoracolumbar fascia	Lower 3 ribs and the fascial connection to the linea alba	Rotation and lateral flexion of the spine
External obliques		Sides of the abdomen	Outer surface of the 6th-12th ribs	Iliac crest, the pubis and the fascial connection to the linea alba	Compresses and supports the abdominal contents
Diaphragm		Beneath the rib cage	Base of the sternum, inner surface of the lower 6 ribs and the upper 3 lumbar vertebrae	Central tendon of diaphragm	Draws the central diaphragmatic tendon downwards increasing volume of the thorax
Intercostals		Between ribs	Inferior border of the ribs and costal cartilages	Superior border of the rib below	Elevate ribs to aid inspiration and draws down to aid expiration
Hip flexors	Iliacus	Through the pelvis and onto the femur	Iliac fossa	Lesser trochanter	Flexion and external rotation of the hip
	Psoas major		Lumbar transverse processes	Lesser trochanter	Flex hip Unilaterally assist to laterally flex the spine May laterally rotate
Gluteus maximus		Bottom	Scrum, coccyx, iliac crest	IT band and gluteal tuberosity	Extend hip Abduct hip Laterally rotate hip
Abductors	Gluteus medius	Outside of upper thigh	Iliac crest	Greater trochanter	Anterior fibres: Abduct and flex hip Posterior fibres: Extend and laterally rotate the hip
	Gluteus minimus		Ilium	Anterior surface Greater trochanter	Abducts, medially rotates and flexes the hip
	Piriformis	Posterior hip	Anterior of Sacrum	Superior aspect Greater trochanter	Laterally rotates hip
	Tensor facia latae	Outer thigh	Iliac crest and posterior ASIS	Iliotibial tract	Abducts, flexes and medially rotates the hip

Muscle		Location	Origin	Insertion	Action
Adductors	Adductor magnus	Inner thigh	The base of the pubis and ischium	Mid to lower femur	Adduction, internal rotation and extension of the hip
	Adductor longus		Anterior pubis	Mid femur	Adduction and internal rotation of the hip
	Adductor brevis		Anterior pubis	Upper femur	Adduction and internal rotation of the hip
	Pectineus		Anterior, superior pubis	Posterior, upper femur	Adduction and flexion of the hip
	Gracilis		Anterior, inferior pubis	Medial, upper tibia	Adduction and flexion of the hip
Sartorius		Front and inner thigh	Anterior superior iliac spine	Medial, upper tibia	Flexion, abduction & external rotation of the hip Flexion and internal rotation of the knee
Quadriceps	Rectus femoris	Front of thigh	Anterior superior iliac spine	Anterior, upper tibia via the patella tendon	Flexion of the hip and extension of the knee
	Vastus lateralis		Greater trochanter and lateral surface of the femur	Anterior, upper tibia via the patella tendon	Extension of the knee
	Vastus intermedius		Anterior and lateral surface of the femur	Anterior, upper tibia via the patella tendon	Extension of the knee
	Vastus medialis		Medial surface of the femur	Anterior, upper tibia via the patella tendon	Extension of the knee (especially last 20 degrees)
Hamstrings	Biceps femoris	Back of thigh	Ischium and posterior surface of the femur	Head of the fibula	Extension and external rotation of the hip and flexion of the knee
	Semitendinosus		Ischium	Upper, medial surface of the tibia	Extension of hip, flexion of knee and tilts the pelvis posteriorly
	Semimembranosus		Ischium	Upper, medial surface of the tibia	Extension of the hip, flexion of the knee and tilts the pelvis posteriorly
Gastrocnemius		Calf	Posterior, lower femur	Calcaneus	Plantar flex the ankle
Soleus		Calf	Upper, posterior tibia	Calcaneus	Plantarflexion of the ankle
Tibialis anterior		Front of lower leg	Lateral, upper tibia	1st metatarsal and medial tarsal	Dorsiflexion and inversion of the ankle

The neuromuscular system is the nervous system and the muscular system working together. Every movement in the body requires communication between the brain and muscles.

The Nervous System

Sending, receiving and processing nerve impulses throughout the body is the responisbility of the nervous system. It controls and communicates and ultimately dictates movement.
It is a communication network that at its simplest level can be broken down into 3 basic elements: 'sensation', 'analysis' and 'response'.



The nervous system is made up of network or neurons and coordinates with other body systems to achieve necessary functions and outcomes. The most important connection of systems to a fitness professional is arguably that of the nervous system and muscular system – it is referred to as the neuromuscular system.

Messages are sent and received from around the body via neurons, allowing the body to adapt to situations in the environment.
The human body has millions of neurons which connect to the spinal cord and the brain, where we are able to process the impulses and make the appropriate and necessary reaction/response.

Components of the Nervous System

There are 2 major divisions of the nervous system (the central nervous system (CNS) and the peripheral nervous system (PNS)).

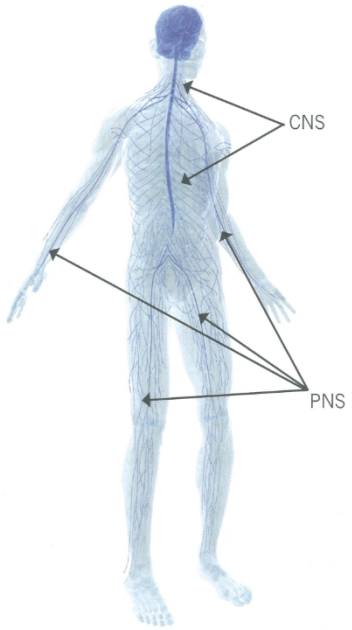
The brain and spinal cord make up the central nervous system, whilst all other neural elements come from the peripheral nervous system.

The Central Nervous System

The cerebellum (lower part of the brain) is responsible for controlling the group action of muscles and is the hub of the CNS. The spinal cord communicates between the brain and the PNS (below the head) by integrating incoming information and producing responses via the reflex mechanism.

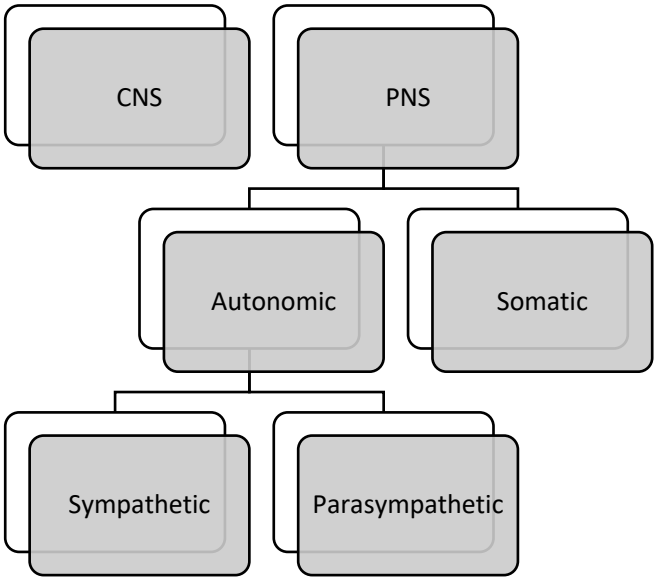
The Peripheral Nervous System

All of the nerves (bundles of neurons) outside of the spinal cord form the PNS. Peripheral nerves connected to the spinal cord are divided into sensory and motor neurons. Sensory neurons are nerve cells that feed into the spinal cord and, connecting with sensory receptors throughout the body to relay information to the CNS. Motor neurons are nerve cells that exit the spinal cord and send out impulses from the CNS to organs, muscles and glands causing them to contract/secrete. The PNS is further split into the somatic and autonomic systems. The somatic are nerves which serve the outer areas of the body and skeletal muscle. They are responsible for voluntary movement and conscious interaction with the external environment. The autonomic supplies neural input to the involuntary body systems such as the heart, and is responsible for the unconscious regulation of homeostasis

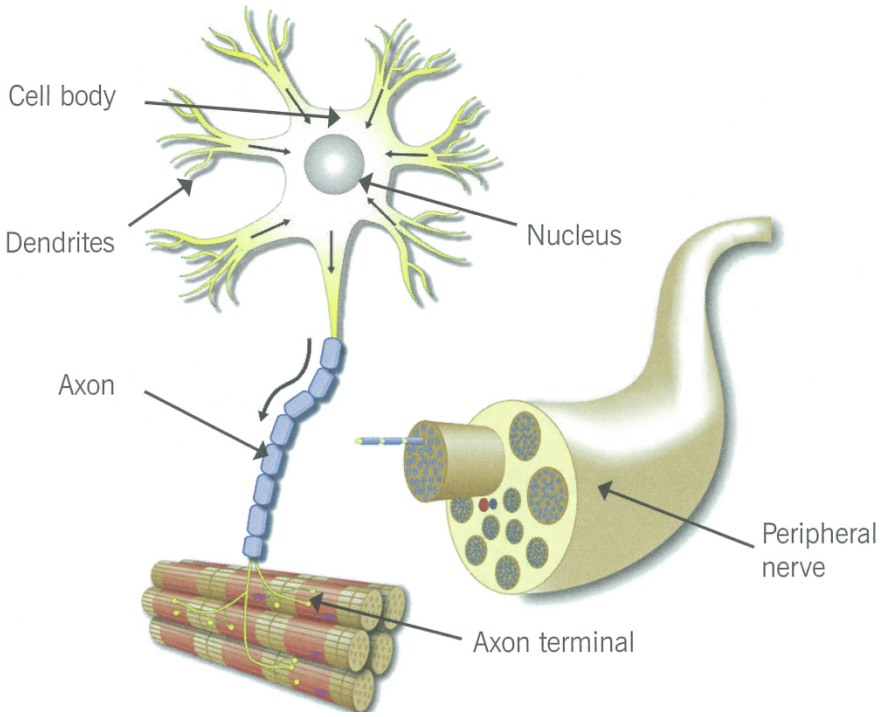


The Autonomic Nervous System

The autonomic system is further split into the sympathetic and parasympathetic systems. In terms of exercise, this system will either speed up (sympathetic) or slow down (parasympathetic) internal processes and levels of activation. In preparation for activity our sympathetic system is working whilst during rest and recovery our parasympathetic nervous system is at work.



The Structure and Function of a Neuron



A neuron or nerve behaves like a cable or wire. It allows signals or impulses to travel from one part of the body to another. The distance may be short or relatively long. Different neurons have the same fundamental anatomical features

Key Anatomical Features:

- Cell body
- Axon
- Dendrites

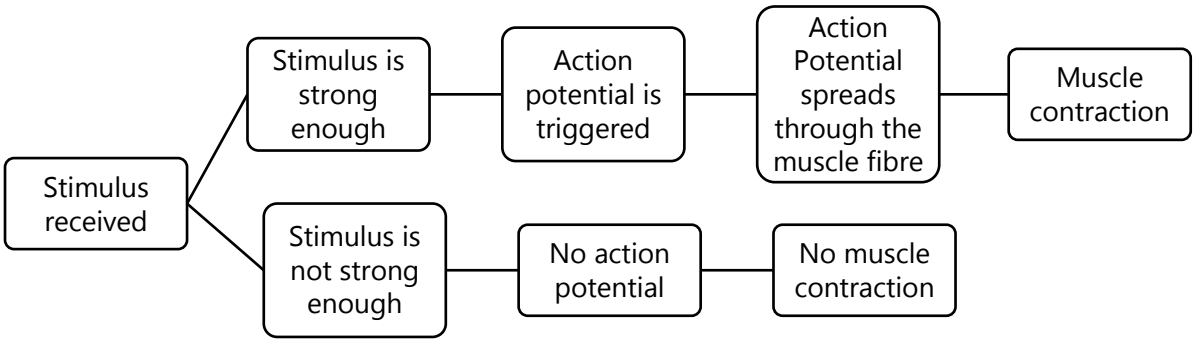
Cell Body (Soma)	•Contains all of the necessary components of a cell such as a cell body, endoplasmic reticulum and ribosomes, and mitochondria. •Regulates cell activity. •If the cell body dies the neuron dies.
Axon	•A long cable-like projection that transmits the action potential and carries the electrochemical message along the length of the cell. •Axons within the peripheral sensory and motor neurons are covered in a myelin sheath which acts as a thin insulating layer. •The myelin sheath helps to speed up the action potential as it travels along the axon. •At the end of the axon is the axon terminal which is the interface between the neuron and other cells.
Dendrites	•These carry incoming action potentials. •Small branch-like projections which make connections to other cells to allow communication with them or the perceived environment. •Can be found on one or both ends of a cell. •Sense the stimulus.

Transmission of a Nervous Impulse – Action Potentials, Axon Terminals and Neurotransmitters

The term action potential refers to a wave of electrical activity that passes along electrically excitable cells. It is created through the movement of sodium and potassium into or out of the cells along the outer membrane. At the end of the axon terminals are swellings/ 'synaptic end bulbs' which contain small sacs of the neurotransmitter acetylcholine (ACh).
When the action potential reaches the end of the axon terminals the ACh is released into the gap at the end (synaptic cleft/gap). The ACh then diffuses across the space to the muscle membrane where is binds with specialised receptors. This then triggers a muscle action potential and stimulates the muscle to contract.

The Motor Unit and Motor Unit Recruitment

The neuromuscular system is the interaction between the muscular system and nervous system – where our nerves communicate with our muscles. Physical abilities such as strength, power and endurance, balance, reactivity and coordination are all governed by how well these two systems communicate. The nervous system relates to our muscular system via motor units in the process below.



A motor unit cannot vary the amount of force they generate. They either contract maximally or not at all – the 'all or none' law

The number of muscle fibres in a motor unit varies depending on the purpose of the muscle. A motor unit in the vastus lateralis will have a large number of fibres as it is required to generate a big force. This means an action potential can generate more power. A motor unit found in the rectus of the eye will have a small number of fibres as it generates very small forces to control the fine movements. Motor units can be stimulated in isolation or with another depending on the muscle action. Stimulating units at the same time will achieve a short, sharp, strong contraction. An alternating sequence over a longer period of time achieves a less intense, longer contraction. Adjusting the number of motor units recruited, along with the frequency of their discharge can

control the force. Recruiting more motor unit and increasing the frequency of discharge creates more tension.

Motor units are recruited in order of size. Coordinating motor unit activity is key to optimising force generation and improving exercise performance		
The smallest motor units contain few type I fibres and generate small forces for fine movements	Intermediate motor units contain large numbers of type I or type IIa fibres and are recruited in addition to the small motor units when a moderate force is needed	Large motor units contain large numbers of type IIb fibres and are only recruited in addition to small and intermediate units to overcome heavy loads or create explosive movements

Neuromuscular Adaptations to Training

Most types of training effect the nervous system. If the nervous system is developed, the muscular system will follow and overall performance will improve and improvements in speed, acceleration, coordination, strength, endurance, and other aspects of fitness can be seen.

Early improvements will be seen in the CNS (especially with resistance training) where smoother and more accurate movement patterns will lead to a greater performance. Regular structured exercise will result in improvements in neural control and coordination of muscular force generation and performance. Improvements include; improved reaction times, greater force production, improved timing of movement, enhanced stability and balance, better exercise technique

The Muscular System

To achieve human movement we are reliant on muscle tissue pulling on bone in order to produce motion at a moveable joint. The movements possible at each joint are dependent on the design of that joint, the origin and insertion point of the muscles and the angle at which the fibres cross the joints.

There are three types of muscle tissue and each one has a different role to play in the body.

Cardiac Muscle	Smooth Muscle	Skeletal Muscle
Involuntary controlled by the autonomic nervous system. Located at the heart.	Involuntary controlled by the autonomic nervous system Located at digestive system and walls of blood vessels	Voluntary controlled by the somatic nervous system. Any muscle that is used to achieve movement of a body part.

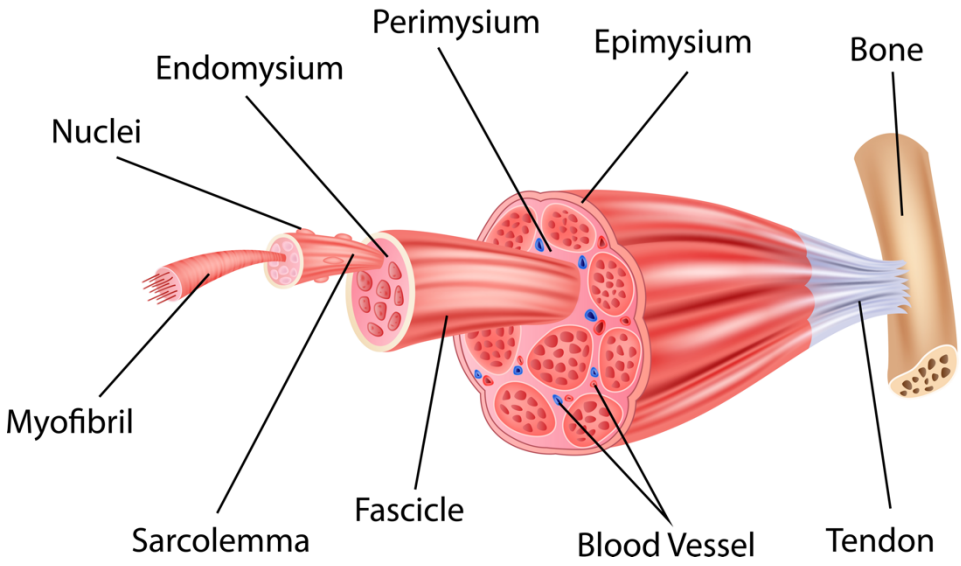
Skeletal Muscle

Many different systems integrate during movement with the driving force being the muscular system. To achieve human movement we are reliant on muscle tissue pulling on bone in order to produce motion at a moveable joint. Movements possible at each joint is dependent on the design of that joint, the origin and insertion point of the muscles and the angle at which the fibres cross the joints.

Basic anatomy of these muscles helps us to understand how these movements occur.
The main constituents of skeletal muscle are:

- 70% water.
- 23% protein, e.g. actin and myosin (elastin) and connective tissue (collagen).
- 7% minerals (e.g. calcium, potassium and phosphorus) and substrates (e.g. glycogen, glucose and fatty acids).

The Cellular Structure of Skeletal Muscle



Skeletal muscle is striated tissue and therefore has a striped appearance when looked at under a microscope. A number of rod like structures called muscle fibres run parallel along the muscle length and each fibre is constructed from smaller parallel fibres and so on.

Muscles are surrounded and protected by a series of collagen-based membranes. The outer layer that covers the whole muscle is called the epimysium (epi meaning upon). In each epimysium there are groups of muscle fibres formed into bundles of fasciculi.

A perimysium (peri meaning around) forms an outer sheath around each fascicle. Within each fascicle are bundles of muscle fibres separated from the other by another membrane called the endomysium (endo meaning inside). Myofibrils form the individual muscle fibres and they contain the contractile proteins, myofilaments, which are needed for generating force. The myofibrils, actin and myosin, are arranged in compartments called sarcomeres which are the smallest unit and repeat along the fibre (under a microscope these appear as dark bands and give skeletal muscles their striated appearance).

The connective tissue continues throughout the length of the muscle fibres and beyond to where it converges to form tendons. Tendons (strong, inelastic, strap structures) attach the muscle to the periosteum that coats the bone. Force production is transferred from the muscles to the skeleton via the tendons.

Summary of Key Points

The whole muscle belly is wrapped in **epimysium** which holds the samller fasciculi

Bundles of fibres, or **fasciculi**, are wrapped in **perimysium**

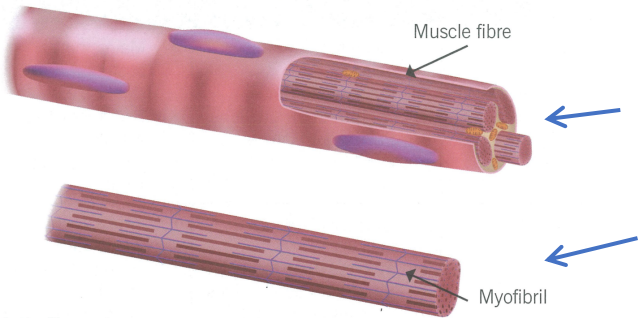
Each muscle fibre is seperated by its own membranous sheath called the **endomysium**

Inside single muscle fibres are **myofibrils** - the smallest unit

Within myofibrils are **sarcomeres** which contain the **myofilaments** – actin and myosin

Force Generation and the Sliding Filament Theory

For force generation to begin the two contractile proteins (actin and myosin – also referred to as thin and thick filaments respectively) must be activated.



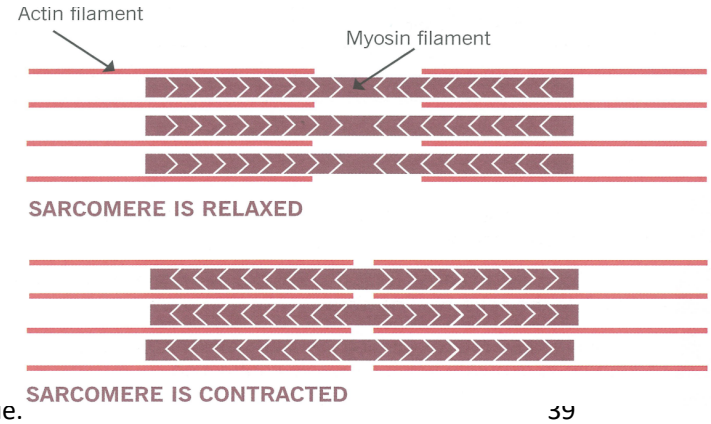
The 2 contractile proteins (actin and myosin) begin force generation

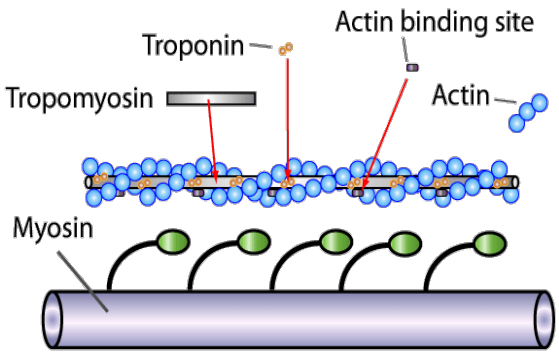
They are arranged into compartments in the sarcomere

The sarcomeres run the length of the myofibril

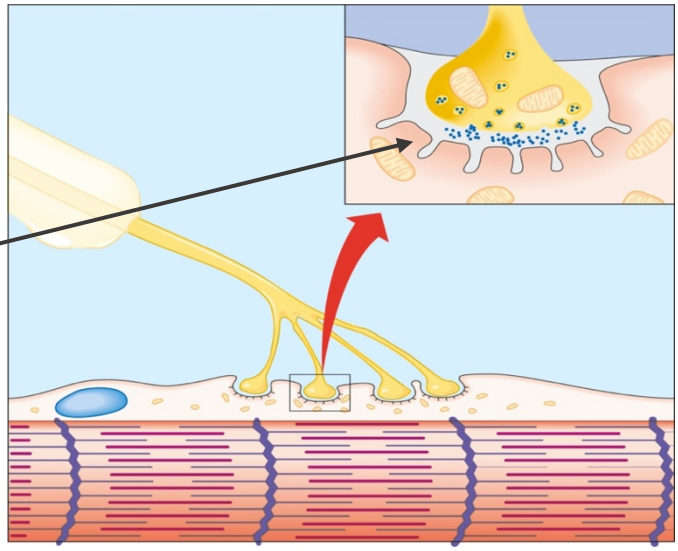
The actin is anchored to the ends of the sarcomere whilst the myosin sits within the middle → The myosin has 'hook like' projections referred to as heads → During contraction the myosin heads attach themselves to the actin filaments and rotate, pulling on them → The actin is then drawn inwards, pulling the ends of the sarcomere together

The power to drive the myosin head comes from the ATP → It primes the myosin head ready for binding → When the conditions are right the head will bind with actin



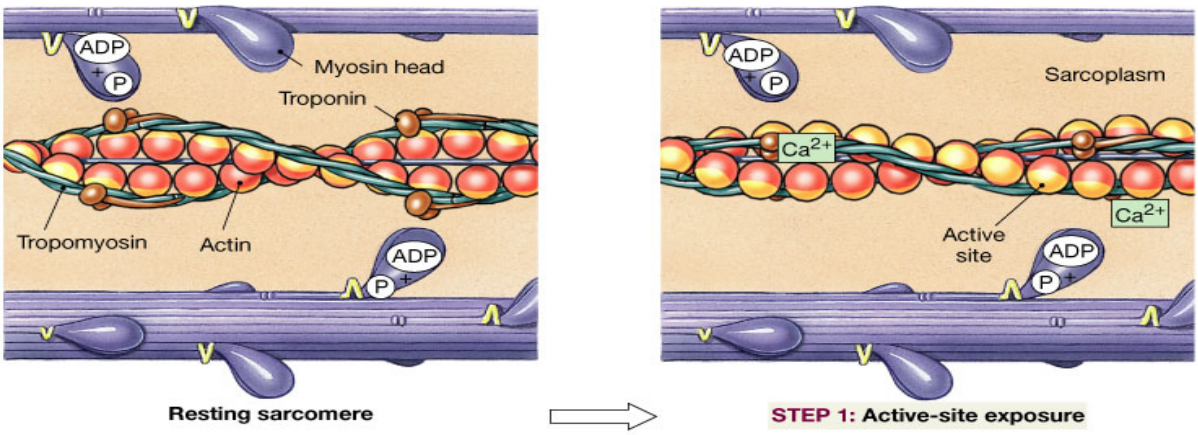


Although primed with ATP, the myosin heads cannot bind to actin without calcium. When relaxed, the active sites on actin are blocked by troponin and tropomyosin.



Surrounding the myofibrils is a network of tubes called the sarcoplasmic reticulum (SR) – calcium reservoirs. An action potential travels along the sarcolemma to produce a nervous system stimulation of the SR causing a release of calcium into the sarcoplasm.

The calcium causes the blocking molecule (troponin) to move away from the myosin binding site. The primed myosin head can then attach to the actin and rotate in the power stroke. ATP then binds to the myosin head to release it from the binding site to re-set.



Summary of Information

1	Cocking phase	ATP is broken down and energy is released to prime the myosin head into a cocked position
2	Binding phase	Calcium ions are released from the SR and allow the myosin head to attach to the actin binding sites
3	Power stroke	The myosin head rotates and pulls the actin towards the centre of the sarcomere, generating tension/ muscle contraction
4	Re-setting	ATP binds to the myosin head, releasing it from the actin binding site

Skeletal Muscle Fibres

There are two categories of muscle fibre that we identify with mostly when exercising. Specific activities can influence different muscle fibre types.

1
- Type I
- Most aerobic in nature
- Greater blood supply and mitochondria
- Long duration activities with lower intensity

2
- Type IIa
- Intermediate fibres
- All the characteristics of other fast twitch fibres
- Ability to adapt and adopt characteristics of type I depending on the training stimulus

3
- Type IIb
- Very anaerobic in nature
- Reduced blood supply compared to type I
- Significantly lower mitochondria
- Short bursts, high intensity, higher force and power outputs

The volume of the different muscle fibre types are dependent on genetics and training people will have more of one variety of muscle fibre which will have a significant impact on athletic ability.

Effects of Different Types of Exercise on Different Muscle Fibre Types

Exercise Type	Effect
Aerobic, long slow endurance training	Type I or Type IIa fibre changes: Improved efficiency and work capacity Increased number and size of mitochondria Increased aerobic enzyme levels Increased capillary density No change to Type IIb fibres
Anaerobic, heavy resistance training	Type IIa and IIb fibre changes: Increase in anaerobic enzyme levels Increased phosphocreatine stores Hypertrophy Increased contractile protein density No change to Type I fibres except hypertrophy

Types of Muscle Contractions

There are a number of terms to describe different muscle actions that are listed in the table below.

Isotonic	Muscles either contract and shorten or relax and lengthen: • Concentric contraction: Muscle generates force whilst shortening i.e. the lifting phase of a bicep curl • Eccentric contraction: Muscle begins to relax whilst lengthening i.e. the down phase of a bicep curl
Isometric	The muscle remains the same length under tension i.e. pausing at the bottom of a push up

Muscle Actions

When muscles contract and shorten they pull on bones to create an action or movement. Efficient movement is dependent on the coordinated activity of whole groups of muscles and involves a variety of muscle actions

Agonist/ Prime mover	The muscle that causes the desired action
Antagonist	The opposing muscle to the agonist
Synergist	The muscle that assists or modifies the movement of the prime mover
Fixator	The muscle that stabilises the part of the body that remains fixed

Muscle Proprioceptors

Proprioceptors are sensors in the muscle and connective tissue of the limbs. Their role is to provide feedback on joint angle, muscle length and muscle tension which is then integrated to give us information about the position of the limbs. Once we have this information we can respond accordingly, such as recruiting more motor units or using a different force.

Stretch Reflex and Autogenic Inhibition

Different types of proprioceptors provide different sensory information. Muscle spindles detect changes in muscle length, whilst Golgi tendon organs (GTO) detect changes in muscle tension.

Muscle Spindles

Located deep in the muscle fibre, muscle spindles are wrapped tightly around like a coiled spring. They sense changes in muscle length and the rate it occurs to cause muscular contraction. The stretch reflex is a protective mechanism for preventing muscle tears caused by overstretching, therefore when the muscle changes length the coils are pulled apart or pushed together. When

the muscle is rapidly lengthened the change in the muscle spindle stimulates neural firing and an action potential is sent to the spinal cord. The signal is then transmitted to the motor neuron which relays an action potential to the muscle. The muscle then contracts rapidly and shortens back up to prevent damage – 'the stretch reflex'
Muscle spindles are activated proportionally to the speed of the stretch. During a static stretch the muscle spindles will be firing and contract against the stretch. Holding the stretch should desensitise the spindle to relax the muscle.

Golgi Tendon Organs

Located in the tendon, GTOs are inelastic so cannot detect change in length. When a muscle contracts it pulls on the tendon creating tension which the GTO can measure. When activated it sends a signal to the spine which has an inhibitory effect on the muscle. The relaxation response caused by the GTO firing is called autogenic inhibition or the inverse stretch reflex. This is exploited during PNF stretching where the muscle is contracted against resistance to stimulate the GTO and relax the muscle. The muscle is then susceptible to stretching and can be lengthened further.

Muscle Spindle and GTO interaction in Movement

As movements are carried out the muscle continually changes length and the spindle is constantly activated. This provides the CNS with valuable information about muscle length and where body parts are. The muscle spindles also cause the contraction that helps movements being performed. After muscular contraction the GTO responds and inhibits muscular contraction to allow the opposite movement to be performed. Muscle spindles and GTO work like on/off switches for muscle activity. During explosive plyometric exercises the rapid lengthening of the muscle activates the muscle spindle, this causes a reflex contraction and causes a more explosive contraction. If this sort of training is carried out more frequently the firing thresholds of the muscle spindle are lowered and motor units are more synchronised leading to more powerful and explosive movements.

Reciprocal Inhibition

The reflex inhibition of the antagonist muscle when the agonist contracts. All body movements are coordinated with muscles working together and to control the movement patterns effectively, muscles must be stimulated in various patterns and sequences. The antagonist must be relaxed for the agonist to contract – therefore the motor units in the antagonist must be inhibited. This process is called reciprocal inhibition and is a necessary part of everyday movement. This reflex operates to ensure smooth, coordinated and explosive movements without resistance from the opposing muscle.

Neuromuscular Adaptations to Training

Most types of training effect the nervous system. If the nervous system is developed, the muscular system will follow and overall performance will improve and improvements in speed, acceleration, coordination, strength, endurance, and other aspects of fitness can be seen. Early improvements will be seen in the CNS (especially with resistance training) where smoother and more accurate movement patterns will lead to a greater performance. Regular structured exercise will result in improvements in neural control and coordination of muscular force generation and performance. Improvements include; improved reaction times, greater force production, improved timing of movement, enhanced stability and balance, better exercise technique

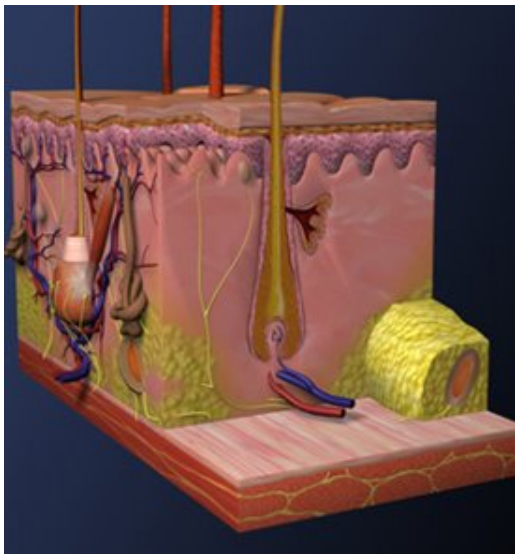
Effects of Sports Massage

The autonomic nervous system is stimulated/soothed during massage.

A vigorous massage will have a sympathetic effect, increasing the production of adrenaline and endorphins in the client's body and stimulating their mental and physical states. It will also help improve body awareness by improving the nervous system function.

A massage that engenders a parasympathetic response should release tension within the tissues and reduce blood pressure, cause the client to feel more relaxed and less stressed. Inducing parasympathetic activity aids in decreasing anxiety, improving sleep and reducing perceived pain. Massage will interfere with nociceptive pain pathways that reach the spinal cord, lessening the feelings of pain and discomfort. For example, the trigger point technique can be used to specifically target local areas of pain and increase fluid circulation within that area, lowering pain in the process. This is done by stimulating the cutaneous mechanoreceptors that block the signals before they reach the spinal cord. As the brain will never receive those pain signals and therefore your perception of the pain is reduced.

Section 4: The Skin



The skin is the largest organ in the body and is part of the integumentary system. It provides the body with the first line of defence against injuries and infection, without it we would be seciptable to many pathogens and we would lose a lot of our bodies water. The skin also helps to regulate body temperature as well as allowing us to have sensations such as heat, cold and even pain!

There are two main layers

Epidermis
Dermis

Epidermis

The epidermis is the tough, protective outer layer that contains the melanin producing melanocytes. The melanocytes are found in the basal layer of the epidermis and control the pigmentation of our skin by increasing concentrations of melanin in response to UV light.

The epidermis has the following characteristics:

- Skin cells in five separate layers (*Horny, clear, granular, prickle cell, basal*.).
- Forms outer layer of skin
- Protects the dermis

Dermis

The dermis is a lot thicker than the epidermis. It is comprised and formed mostly from connective tissue, elastin and collagen fibres.

The dermis contains the following structures:

- Hair follicles
- Sweat glands
- Fat cells
- Nerves and sensory receptors (touch, heat, cold, pain etc.)
- Blood and Lymphatic vessels
- Sebaceous glands
- Arrector pili muscles

There is a tiny muscle attached to the base of the hair follicle at one end, and to the dermal tissue at the other. When the body is cold, the arrector pili muscles contract all at once, causing the hair to stand up on the skin and generating heat.

Functions of the Skin

p
- **Protection** from pathogens and infection with the presence of Keratin. Avoids injury using reflexes from our responses to stimuli (events)

R
- **Regulation of temperature** as sweat glands and vasodilation of superficial vessels enables heat loss through convection, conduction and radiation.

E
- **Excretion** of sweat which is 99% water and 1% mineral salts

S
- **Sensation** - detects temperature and pain via our recptors and nerve endings.

S
- **Secretion** of oily and mildly acidic sebum to lubricate and protect the skin.

D
- **Formation of Vitamin D,**, melanin and other chemicals.

Skin Condition

There are a vast number of factors that will affect the skin's condition, appearance and sensitivity. These can include genetics, UV Exposure, diet/nutrition and hydration levels, general health, smoking and drinking alcohol. The effects can be quite astounding, reducing elasticity and hydration levels in the skin.

Keratin helps to repair damaged cells (cuts, bruises), creates a protective barrier in the skin to protect it against bacteria (maintaining good health) and helps strengthen teeth and nails.

Effects of massage on the skin are varied. Specific techniques are able to reduce the formation of keloid and scarring of soft tissue (not just within the muscle). Circulation is also enhanced through increased vasodilation of the capillaries and increasing oxygen delivery. Increasing the skin's temperature also enables the improvement of evaporation of sweat and removal of waste products.

Section 5: The Respiratory System

Function of the Respiratory System

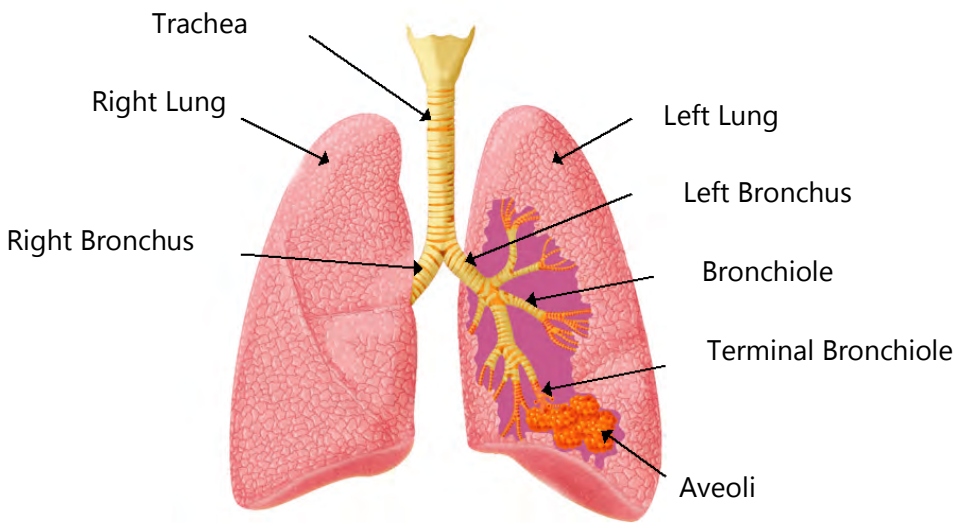
The respiratory system is responsible for taking oxygen into the body and removing the waste product of aerobic respiration – carbon dioxide. All body functions require oxygen, so respiration and the exchange of gases (taking in oxygen and removing carbon dioxide) happens continuously without conscious thought or control (involuntarily). Whilst there is limited control over breathing (you can choose to hold your breath), ultimately breathing is controlled by the autonomic or involuntary nervous system. However, breath can be brought under conscious control; disciplines such as Pilates and yoga control and use breathing techniques as part of their practice

Composition of Air

GAS	INHALED AIR	EXHALED AIR
(N2) Nitrogen	79%	79%
Oxygen (O2)	21%	17%
Carbon Dioxide (CO2)	<1%	4%
Trace Gases	<0.001%	<0.001%

The body breathes in response to several triggers. Rising levels of carbon dioxide in the blood and receptors in the intercostal muscles cause involuntary breathing.

Structure of the Respiratory System



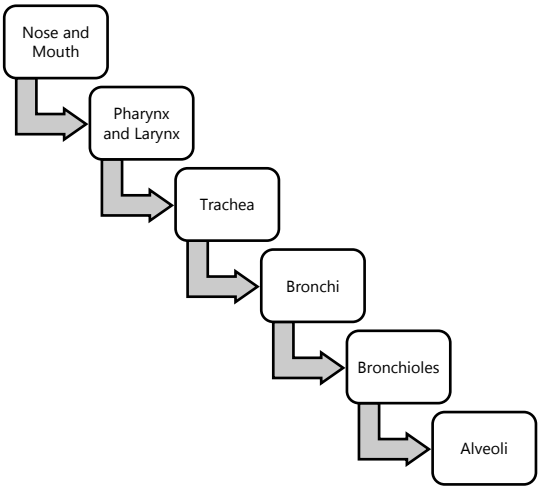
Component	Structure
Pharynx	Comprised of skeletal muscle and funnel shaped, it connects both the nasal cavity and the mouth to the Larynx. Approximately 10-13cm in length from base of skull to the 6th vertical vertebrae
Larynx	Commonly referred to as the voice box. It is a rigid wall of muscle and cartilage which contains the vocal cords. It connects the pharynx and trachea and is approximately 5cm in length.
Trachea	Commonly called the windpipe. Comprised of rings of cartilage, it is very flexible and is roughly 12cm by 2cm in width. It Branches into the right and left bronchi in front of the oesophagus.
Bronchus	Referred to as "bronchi" in the plural, they made up of cartilage rings that give them a level of stability and strength, leading into the bronchioles.
Bronchioles	Bronchioles or bronchioli also have terminal bronchioles (at the end). They are tubular in shape and around 1mm in diameter, made up of connective tissues and smooth muscle.
Alveoli	Similar in appearance to a bunch of grapes or tree blossom - the stem being the bronchioles. The 'grape' like structures are air sacs which cover a large surface area

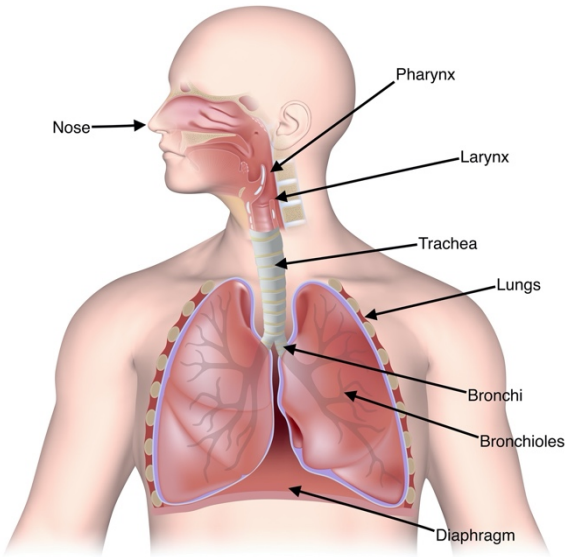
The Mechanics of Breathing

The lungs are two structures that are located in the chest cavity and protected by the ribs. A large muscle at the bottom of the ribcage separates them from other structures. The function of the lungs is gaseous exchange, receiving oxygen and delivering it through the working muscles whilst removing waste products. The two main phases of the breathing cycle are:

- Inspiration drawing air into the lungs.
- Expiration expelling air from the lungs.

As oxygen reaches the capillaries it diffuses into the blood stream and is transported around the body. Carbon dioxide is then diffused in the reverse direction during expiration.

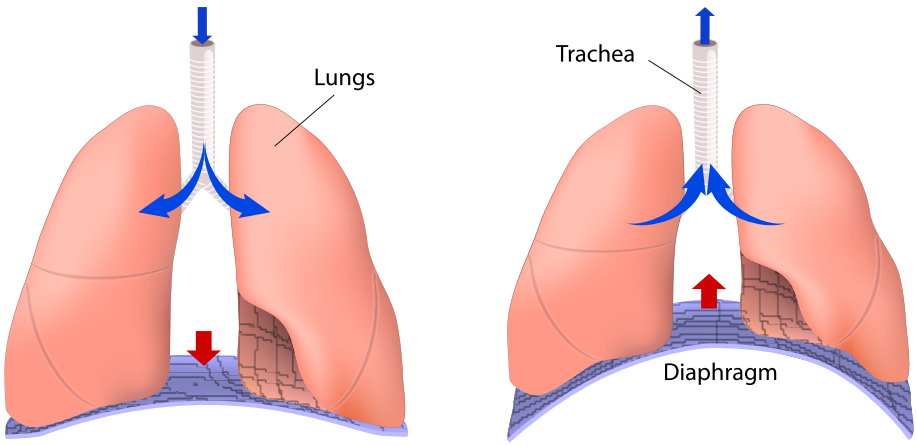




During inspiration the diaphragm muscle contracts causing the normal 'dome shape' to flatten. The external intercostal muscles also contract, raising the ribcage. These actions increase the chest cavity volume. This increase in volume creates a negative pressure between the air in the lungs and air in the atmosphere, like a vacuum effect in which the negative pressure sucks air into the lungs until the two pressures are balanced.

During expiration the diaphragm muscle relaxes and rises returning upwards to its dome shape. The intercostal muscles also relax, decreasing the chest cavity volume. This creates a positive pressure, which 'pushes' some of the air out of the lungs.

During exercise, when breathing becomes more vigorous, the internal intercostal muscles become active. During expiration they contract, forcing the ribs down and removing the air in the lungs



Breath **Exhalation**

Breathing Pattern

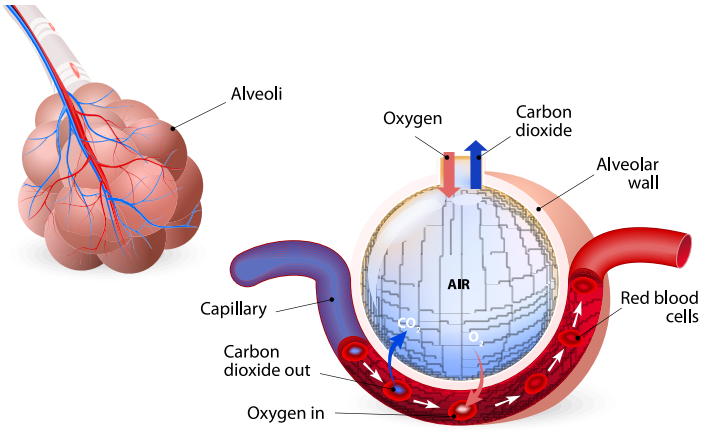
Costal breathing is a shallow pattern of breathing through the chest and involves the contraction of the external intercostal muscles. Individuals with a sedentary lifestyle may develop a pattern of shallow breathing because the diaphragm has reduced space to move. Shallow breathing is also experienced during times of stress.

Diaphragmatic breathing is a deeper method of breathing. The abdomen is encouraged to rise and fall; it involves the contraction and lowering of the diaphragm. Diaphragmatic breathing is promoted in activities like yoga to assist relaxation.

Lateral and thoracic breathing encourage the sides and back of the ribcage to expand during inhalation to maximise the expansion of the ribcage and use of the lower lungs. Breathing in this way allows engagement of the abdominals to be maintained while exercising. It is a very efficient way of breathing (used in Pilates); it also promotes flexibility in the thoracic spine.

Gaseous Exchange

Gaseous exchange occurs in the lungs and the cells of the body. Oxygen (O_2) in the alveoli (lungs) diffuses into the bloodstream (capillaries surrounding the alveoli) and travels to the heart where it is circulated around the body. Then the reverse happens in regard to carbon dioxide (CO_2), it is transported from the body via the blood and diffuses into the alveoli (lungs) where it is removed during expiration.



Diffusion

Gaseous exchange occurs through a process called diffusion, which is the movement of a gas from an area of high concentration to an area of low concentration. The concentration of oxygen decreases between the mouth and the lungs, therefore the gas flows in this direction. Carbon dioxide flows in the opposite direction.
Once oxygen diffuses into the alveoli (air sacs) it continues to follow the concentration gradient and diffuse into the bloodstream. The minute capillaries running over and around the thin alveoli walls are only one cell thick, allowing gases to pass through easily; oxygen passes into the blood and at the same time carbon dioxide passes back into the lungs to be exhaled.

Effects of Exercise on the Respiratory System

Short Term	During exercise tidal volume and breathing rate increase. With a higher rate of inhaled and exhaled air to meet oxygen demand and function effectively!
Long Term	Respiratory muscles become stronger as well as an increase in capillaries around the alveoli. This enhances the potential for gaseous exchange.

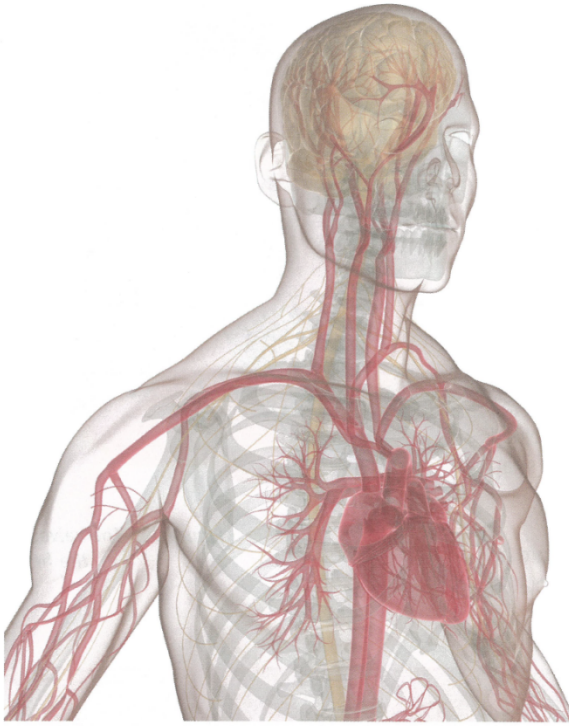
Section 6: The Cardiovascular and Circulatory System

The Cardiovascular and respiratory systems combine to deliver oxygen to muscles and remove carbon dioxide waste product.

The Cardiovascular System

The cardiovascular system also referred to as the circulatory system consists of the heart, blood vessels and blood transported around the body delivering essential nutrients.

The heart is a muscular pump, roughly the size of a man's clenched fist, which pushes blood into the tissues. Located behind and to the left of the sternum, it has 4 chambers: 2 atria and 2 ventricles and is predominantly made of cardiac muscle (myocardium).



Heart Circulation

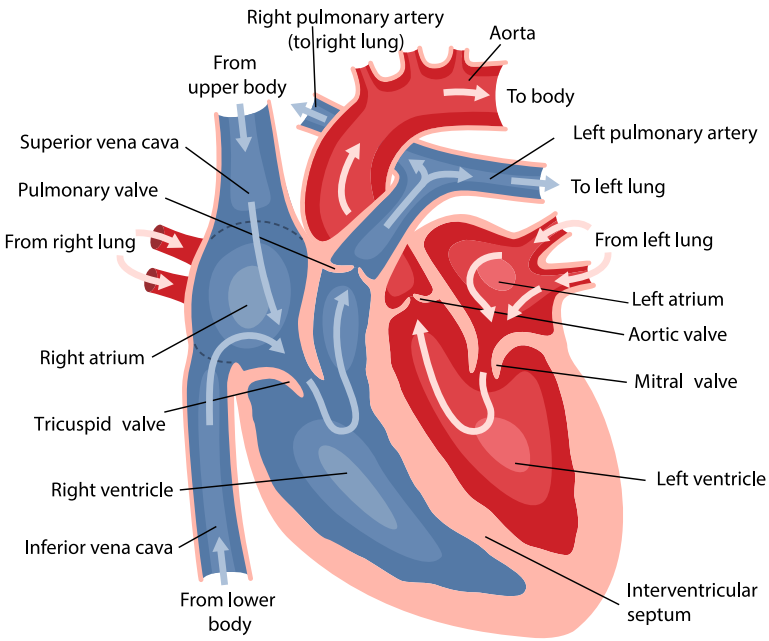
The right hand side of the heart receives blood from the upper and lower body via veins. Blood enters the right atrium through either the inferior or superior vena cava saturated with CO2 (deoxygenated blood).

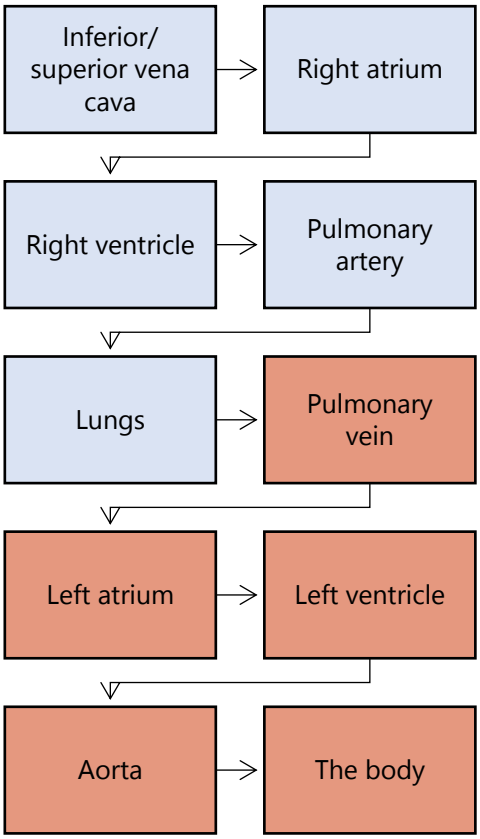
It is ejected to the lungs (pulmonary circulation) by the right ventricle via the pulmonary artery. In the pulmonary capillaries, CO2 diffuses into the lungs to be expired. O2 enters the blood (oxygenated) and enters the left atrium of the heart via the pulmonary vein.

The left ventricle then ejects the blood and o2 via the aorta, to the tissues of the body (system circulation).
Arteries carry blood away from the heart and veins always carry blood to the heart (see below diagram)

Note: The pulmonary artery is the only artery in the body which carries deoxygenated blood away from the away from the right ventricle to the lungs to collect oxygen.

Structure of the Heart





The Valves of the Heart

Unwanted backflow into the chambers is prevented by a number of valves which open and close in response to changes in pressure as the heart contracts and relaxes. They are fundamental to effective circulation as any backflow will compromise the efficiency of each heartbeat.
The main valves are:

Atrioventricular (AV) valves located between the atria and ventricles and prevent backflow from the ventricles to the atria. As the ventricles contract, pressure rises and forces the valves to snap shut and directing blood through the arteries

Semilunar (SL) valves located at the base of the arteries leaving the heart. After each contraction there is a relative drop in pressure in the ventricles as they relax. As blood moves back towards the ventricles the SL valves snap shut so blood cannot re-enter

As the valves snap shut, they are anchored in place by tendon-like chords known as **chordae tendinae** which stop the valve flaps from being pushed too far into the atria and going 'inside out'.

Control of the Heart - Conductive System

The heart is stimulated to contract by a complex series of integrated systems. The natural pacemaker – the sinoatrial (SA) node, initiates the contraction and can be found in the wall of the right atrium. The myocardium is stimulated to contract about 72 times per minute by the SA node. The stimulation is part of the autonomic nervous system.

SA node self excitable – where action potential begins, spreads through the atria. Contracts in a wave like manner

Flow of action potential to the ventricle controlled via AV node

AV node slows down the AP to give atria enough time to contract

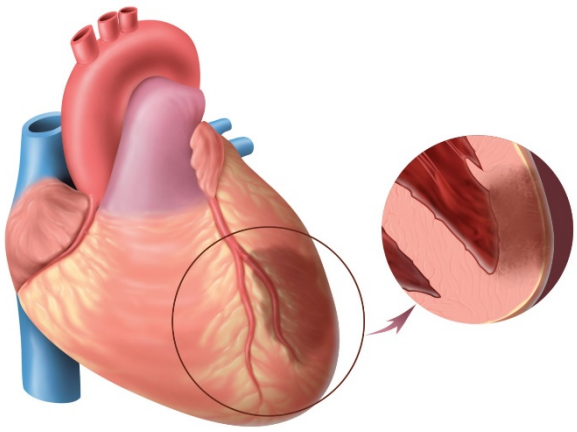
AP then travels down specialised AV node nerve bundles

Bundle of his in the centre of the heart (specialised fibres) transmit impulses from atria to ventricles

Bundles split into 2 at the septum and direct the AP can spread outward and upward into ventricles, directing blood up instead of down (Purkinje fibres)

Coronary Circulation

Coronary circulation is the term used to describe circulation of blood to the heart. The heart has its own network of blood vessels to supply it with constant oxygen and nutrients via 2 coronary arteries (left and right coronary arteries). The arteries branch out from the base of the aorta and divide into a crown-like network of blood vessels across the heart wall.



Blood is circulated through the superficial and deep tissues of the heart before being drained away by the coronary veins. The right coronary artery supplies blood to the myocardium of the right ventricle, whilst the left coronary artery divides into 2 branches to supply blood to the left ventricle and the posterior of the heart. Coronary arteries are susceptible to heart disease due to blood clots, fatty plaques or spasms in the smooth muscle in the vessel walls. These complications reduce blood flow and oxygen and nutrients to the heart muscle causing the heart to fail.

Reduced blood flow is called ischaemia, therefore Myocardial ischaemia is a reduction in blood flow to the heart. It can result in myocardial infarction (heart attack), infarction meaning death of an area of tissue as a result of interrupted blood supply

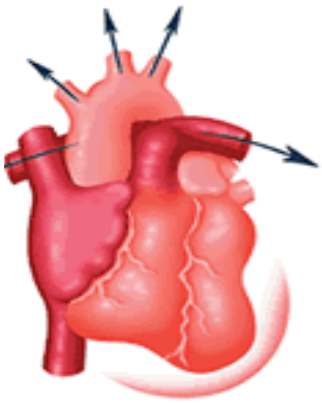
The effect of Disease Processes on the Blood Vessels

Blood flows freely to reach its target tissue or organ in a healthy blood vessel, however vascular disease narrows the blood vessels, which has a negative impact on their performance. Vascular disease is one of the main causes of death in the developed world and is caused by inflammation in the blood vessels and accumulation of mineral, protein and fat deposits creating a build-up of plaque on vessel walls. If an artery becomes inflamed or damaged, plaque will form to attempt to repair the artery. As the plaque builds up the artery becomes thicker, harder and less elastic – therefore narrower and less able to stretch in response to blood flow. As a result the blood flow (and oxygen) is reduced and can causes target tissue death unless those tissues are supplied by alternative arteries. This build up restricts or completely prevents blood flow to tissue and organs, starving the structures of vital nutrients and oxygen.

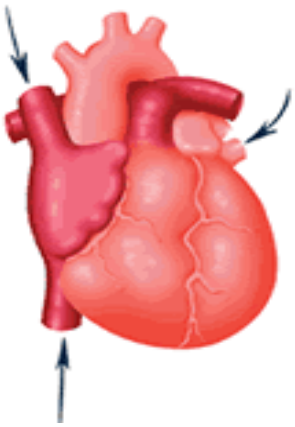
Symptoms include reduced ability to exercise, episodes of chest pain and possibly heart attacks. It is also linked to strokes and kidney disease. Narrowed arteries in the brain can also become blocked by clots resulting in a stroke.

Blood Pressure

Blood pressure (BP) is a measure of force applied by blood to the walls of the arteries as it flows through them. It is an expression of the arterial blood flow and peripheral resistance the blood encounters as it flows around the body.
Blood pressure = cardiac output x total peripheral resistance
It is measured in millimetres of mercury (mmHg) using a sphygmomanometer and is expressed as systolic and diastolic. Optimal BP is below 120/80 mmHg and Hypertension is classed as 140/90 mmHg or higher.



SYSTOLIC
In the systolic phase, the heart contracts, blood pressure rises and blood moves out along the vessels.



DIASTOLIC
In the diastolic phase, the heart relaxes, blood pressure falls and blood fills the heart

Systolic blood pressure is a reading of the pressure that the artery walls are under when the heart contracts and pumps blood around the body.

Diastolic pressure is a reading of the pressure that the artery walls are under when the heart relaxes whilst the chambers fill with blood to be pumped out around the body again.

Cardiac Output is the volume of blood pumped out by the heart in one minute. The greater the cardiac output the faster the heart beats and the greater the blood pressure.

Blood Pressure Classifications

Category	Systolic (mmHg)	Diastolic (mmHg)
Low	< 100	< 60
Optimal	< 120	< 80
Normal	< 130	< 85
High normal – Pre-hypertension	130-139	85-89
Stage 1 Hypertension	140-159	90-99
Stage 2 Hypertension	160-179	100-109
Stage 3 Hypertension	>180	>110

Risks of High Blood Pressure

It is normal for blood pressure to temporarily increase during exertion or when feeling anxious or stressed. Hypertension is the term used to describe blood pressure that is consistently higher than the healthy level when at rest. A high systolic blood pressure (SBP) shows the strain on the blood vessels when the heart is attempting to pump blood out, whilst a high diastolic blood pressure (DBP) shows the blood vessels have little chance to relax between heartbeats. Measuring blood pressure gives an indication of the health of an individual's cardiovascular system and overall health.
The term 'white coat hypertension' is sometimes used if you have high blood pressure readings (consistently 140/90mmHg or above) only when you are in a medical setting.

Short- Term Effects of Exercise on Blood Pressure

A linear increase in systolic blood pressure (SBP) can be seen with increasing exertion, whilst the diastolic (DBP) blood pressure may decrease slightly during exertion due to vasodilation or remain unchanged.
Individuals with hypertension may experience a rise in DBP as a result of an impaired vasodilatory response.

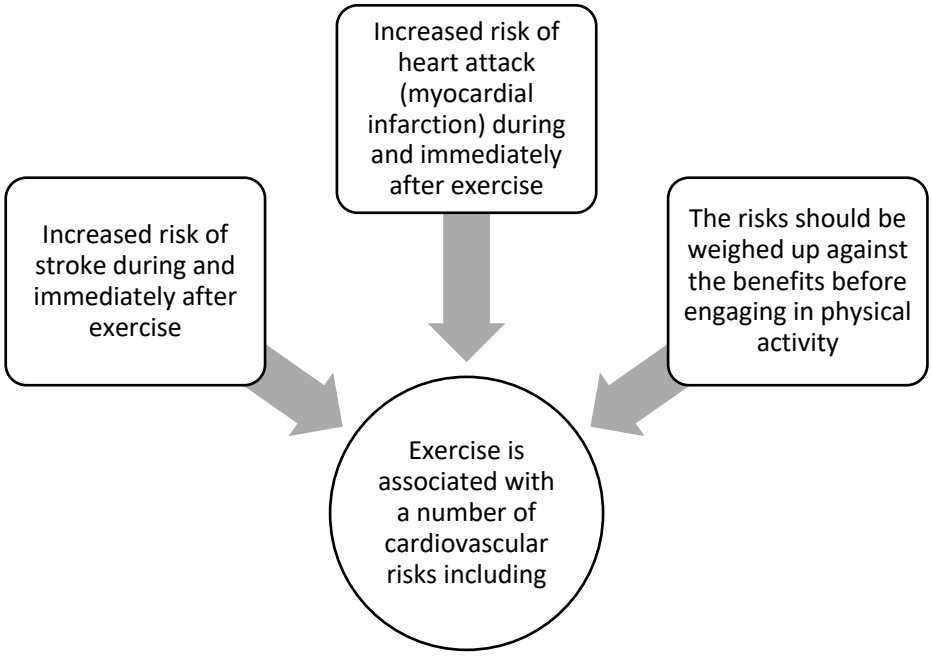
Heavy weight training and isometric exercises increase both SBP and DBP, so it is important not to hold your breath when performing these exercises to avoid the Valsalva effect. This Valsalva manoeuvre involves holding the breath while straining or a forced exhalation against a closed airway and therefore increases the pressure in the thoracic cavity and prevents venous return.

This can increase blood pressure and the risk of a cardiovascular issue such as a heart attack or stroke. To avoid this, inhale as you're bringing the resistance back to its resting position and exhale as you're working hardest against the resistance.

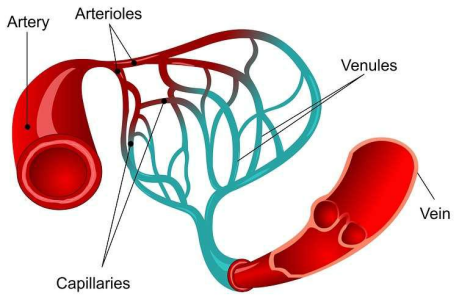
Long-Term Effects of Exercise on Blood Pressure

Aerobic exercise using large muscle groups in a rhythmical activity helps to reduce blood pressure over time. According to Durstine and Moore (2003) endurance training can cause an average decrease of mmHg in both SBP and DBP in mild and moderate hypertensives. Apart from circuit weight training, chronic strength or resistance training has not been shown to lower resting blood pressure. Resistance training can benefit hypertensives, but it is not recommended as a means on its own.

Exercise and Blood Pressure Considerations



Blood Circulation Structure and Function of Blood Vessels



Blood passes through the heart twice, once through the pulmonary system which is the circulation between the heart and the lungs and once through the systemic circuit is between the heart and the body.

Blood vessels are hollow tubes made from smooth muscle with the function of transporting blood around the body. Although there are different types of blood vessel it is important to note that they all form a closed continuous loop and each blood vessel splits to form a different type of blood vessel or joins to another blood vessel. Blood vessel are categorised according to their shape and function, one type of blood vessel is gradually split or linked.

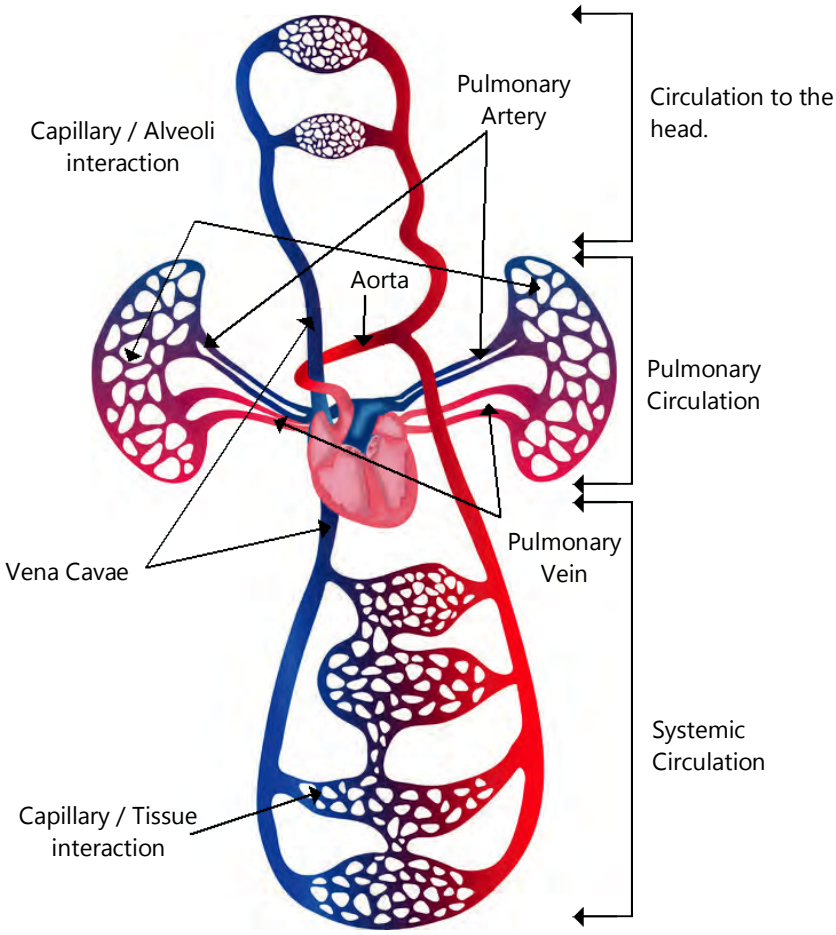
There are three main types of vessel that differ in construction and size, according to their function and position in the body. These are the arteries, capillaries and veins.

Arteries	Thick muscular walls Divide into smaller blood vessels called arterioles All arteries carry oxygenated blood except the pulmonary artery
Veins	Thin walls with little muscle Divide into smaller blood vessels called venules Contain valves to prevent blood backflow
Capillaries	Extremely thin walls to allow diffusion of gases and nutrients

There are two additional sub-types called arterioles (a subdivision of arteries) and venules (a subdivision of veins). These blood vessels are responsible for transporting the blood to and from the heart and delivering nutrients to and from the tissues.

Circulatory Blood Flow

The smooth muscle found in the walls of blood vessels allows them to narrow (vasoconstrict) or widen (vasodilate) to restrict or enable the flow of blood. This results in the redirection of blood flow to different tissues dependent on the state of the body and its requirements. It also plays an important role in the regulation of blood pressure.
For example, after a meal the blood vessels that feed the digestive system are vasodilated and blood flow is increased to assist digestion, while blood vessels feeding the muscles are vasoconstricted, reducing the blood flow.



Contents and Function of Blood

Blood carries nutrients and oxygen to the bodies structures and removes any waste product and comprises of four different components.

COMPONENT:	DESCRIPTION:
Red blood cells (Erythrocytes)	A single drop of blood contains between 240-270 million RBCs so it's safe to say they are pretty prolific. RBCs contain a protein called haemoglobin (Hb) which carries oxygen and carbon dioxide around the circulatory system. RBCs are produced the red bone marrow and are pigmented which is what gives blood its characteristic red colour. RBCs make up approximately 40% of total blood volume. A sound diet containing adequate iron ensures that there are plenty of RBCs – too few can result in anaemia which is characterised by fatigue and poor exercise performance.
White blood cells (Leukocytes)	WBCs are clear and contain no haemoglobin. There are fewer of them, but they too are produced in red bone marrow. WBCs are the cells that fight infection and as infections come in various shapes and sizes, so to do WBCs. There are also fewer than red blood cells around 700 times lower.
Platelets (Thrombocytes)	Platelets are responsible for stopping blood loss and are part of the clotting process. If you cut or otherwise injure yourself, platelets form "plugs" to stop your precious blood escaping. Some medications and diseases can inhibit platelet formation, in particular haemophilia and anti-coagulants such warfarin.
Plasma	Plasma is the carrier medium in which all the other blood cells are supported and transported. It also contains proteins and other nutrients, electrolytes, gases, enzymes, minerals, vitamins and metabolic waste products. Plasma is 91.5% water and 8.5% solids and solutes.

Blood Pooling

Exercising muscles demand blood, especially when intensity is high. Blood pooling occurs when blood in the veins collects in the extremities. Stopping suddenly during intense exercise can contribute to blood pooling. The heart is pumping out larger volumes of blood and when the leg muscles stop working there is reduced assistance in helping the veins return blood back to the heart.

Venous return is an important mechanism for helping the blood flow return to the heart and preventing blood pooling. Long periods of inactivity or pressure (e.g. caused by an airline seat pressing on the veins in the back of the knee) can contribute to reduced blood flow and may slow the blood flow from the lower legs. This can result in blood pooling due to a lack of venous return and a blood clot or deep vein thrombosis (DVT) may then form, blocking the blood vessel.

Cardiovascular Benefits of Endurance Training

There are both short and long term effects of the cardiovascular system; the short term are physiological responses to physical activity such as an increase in heart rate, stroke volume, blood pressure and cardiac output. This represents the body's attempts to deliver more blood around the system to cope with the demands of physical exertion.
Long term changes are the positive effects can be seen in lasting adaptations

Effects of Exercise

Increased growth of cardiac muscle	Larger stroke volume	Lower HR	Stronger & more elastic arteries
Improved blood cholesterol markers	Increased network density of capillary beds	Increased haemoglobin count in blood	Lower BP in long term

Risks:	Increased BP and used of valsalva manoeuvre/ techniques	Postural hypotension/ increased light headedness

Resting cardiac output in the heart of a well-trained athlete will be about the same as in a healthy untrained athlete. Although stroke volume is increased, the heart rate is decreased.

Massage Considerations

With clients with no underlying conditions or health issues, there are two main considerations when carrying out or planning treatment.

When massaging limbs with firm pressure, always work towards the heart. If massage is applied away from the heart with high pressure it could cause damage to the valves in the veins.
Heavy or prolonged pressure on the major arteries should be avoided (the carotid on the side of the neck and the ulnar on the inner part of the clients wrist).

Section 7: The Energy Systems

Energy is needed for the body to function, grow and repair damaged tissue.
This section will cover:

- The chemical compounds that energy is derived from
- The way those chemical compounds are converted into energy
- A focus on the different energy system requirements of exercise

Adenosine Triphosphate: Energy Currency

Our bodies need energy for movement, to produce force against objects, generate heat and to grow and repair. This energy comes from adenosine triphosphate (ATP), of which carbohydrates, fats and proteins play a key role in the complex process of production. Fat and Carbohydrates are the preferred fuel sources, but protein can be used certain circumstances if carbohydrate stores are depleted.

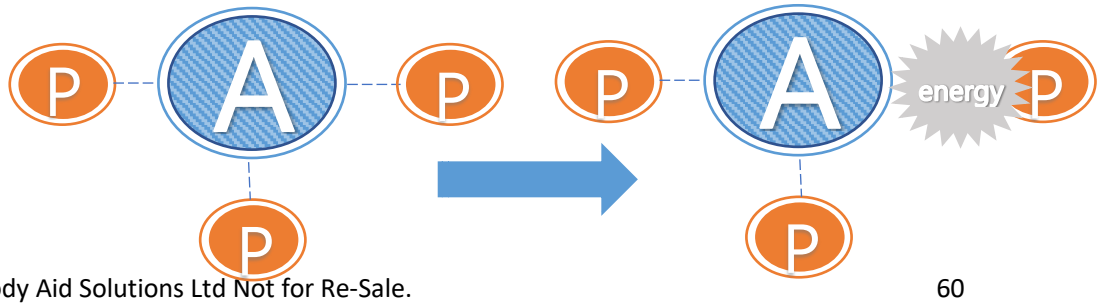
Structure of ATP

ATP provides the energy to drive the sliding filament theory. An energy rich compound it is composed of 1 adenosine molecule and 3 phosphates.
Energy is stored in the high energy bonds that join the 3 phosphate molecules to the larger adenosine molecule. When 1 of the high energy bonds is broken by the enzyme ATPase energy is released leaving an adenosine molecule bound to 2 phosphates and 1 free phosphate.
This reaction occurs during muscular contraction and is controlled by the enzyme myosin ATPase. The ATP stored in the myosin head is broken to ADP (adenosine diphosphate). Release of the ADP causes the myosin head to 'nod' and slide over the actin where it binds with another ATP molecule and detaches from the active site. This continues to happen while there is ATP available, nervous stimulation present and no interference from fatiguing factors

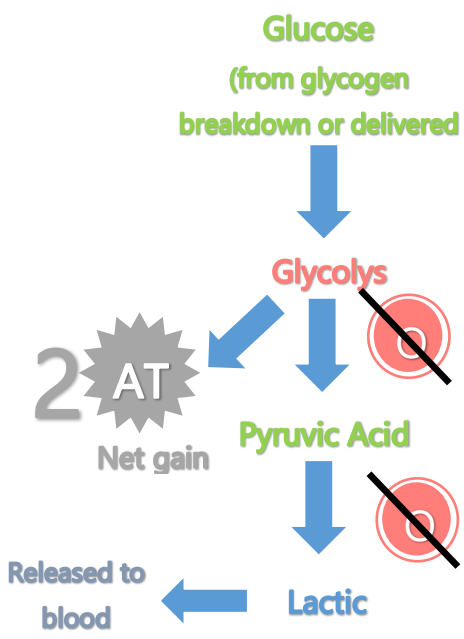
The Energy Systems

The Creatine Phosphate System – Immediate Energy

High intensity, short duration activities e.g. Explosive jumping, 100m sprint, javelin throw or maximal lift are supplied by intramuscular (within the muscle) stores of ATP and creatine phosphate (CP). ATP stores are limited and may only last for the first few seconds of exercise. Once depleted they can be regenerated almost immediately by the breakdown of CP. It has a high energy bond which, when broken down, releases enough to yield and ATP molecule. CP formed naturally and stored in the muscles (120g in a healthy adult) but stores are also limited so only lasts about 10 seconds, however they can be restored after 5 minutes of rest. Stores are replenished by the liver and kidneys breaking down amino acids or taking on dietary creatine - the process does not use oxygen or have immediate demands for carbohydrates or fat.



The Lactate System



This system is generally associated with the burning feeling during high intensity activities and bridges the gap between the CP and aerobic systems. It allows rapid ATP production at a rate greater than the aerobic system and takes 20 minutes – 2hours to recover.

Higher intensity activity that lasts 60-180 seconds e.g. 400m running and 100m swimming, bursts of speed in team sports, 75-85% HR max are fuelled by the system which provides energy by the incomplete breakdown of carbohydrates. The glucose is broken down into pyruvate which follows 1 of 2 paths.

If there is sufficient oxygen the pyruvate will enter the aerobic system but if there is insufficient oxygen the pyruvate is converted to lactic acid. This process yields 3 ATP per glucose molecule and does not use oxygen (anaerobic). When the lactate system is used blood lactate level increases to a threshold level, anything above this level is known as onset blood lactate accumulation (OBLA) which can cause a decline in performance.

Traditional theories denote lactate at the cause of the 'burning sensations' and 'fatigue' during high-intensity activities. Interestingly, research by Robergs et al. (2004) casts doubt on this and suggests that the cause is caused by a concurrent build-up of hydrogen ions associated with lactate, causing the pH level to drop and inducing acidosis.
Acidosis inactivates various enzymes that are involved during energy production and therefore can interfere with muscles' contractile ability (McArdle et al. 2001). This then poses that question of whether lactate production causes an increase in hydrogen ions or whether it simply occurs in tandem.

When ATP is broken down into ADP hydrogen ions are released, normally they are absorbed in the aerobic energy systems however during high intensity activities the breakdown is occurring at a massive rate so the build-up of hydrogen ions is unavoidable. Pyruvate is used to maintain the pH and buffer hydrogen ions by binding with them, forming lactate. It is proposed therefore that the production of lactate is a result of the body attempting to prevent acidosis rather than the cause of it.

Aerobic (Oxygen) System

This system produces ATP from the complete breakdown of carbohydrates and fats in the presence of oxygen during low to moderate intensity exercise (up to 75% HRmax) e.g. Sleeping, light aerobic activities. It produces carbon dioxide, water and heat as by products, lactic acid does not accumulate due to the presence of oxygen. There is no limit on the amount of ATP that can be produced, however there is a limit on the rate of production. Recovery time is dictated by how long it takes to eat, drink and replenish fuel stores. Fat is said to burn in a carbohydrate flame which means it cannot be broken down without carbohydrate present, relative proportions of fat and carbohydrates burnt will depend on nutritional status and exercise intensity. At low intensities fat provides the fuel, but as energy demand increases as ATP is needed quicker Carbohydrates contribute.

Energy Systems and Training Adaptations

Aerobic Training Adaptations

The main limit on exercise is the ability to take in, transport and utilise oxygen

Pulmonary Changes

- Improvements in the efficiency of the respiratory muscles
- Increased maximal breathing rate and tidal volume
- Use less oxygen and produce fewer waste products
- Increase oxygen availability to working muscles

Cardiovascular changes

- Significant hypertrophy and coronary blood flow (greater capacity for work)
- Increased stroke volume, lower resting heart rate and greater cardiac output at maximal heart rates
- Increased blood plasma volume and greater blood flow to working tissues
- Changes in control of blood distribution, increased arterial diameter and capillary density

Muscular Changes

- Improved blood supply gives a greater ability to extract and utilise oxygen from the blood
- Increased size and number of mitochondria meaning greater ATP production
- Significant increase in the volume of aerobic enzymes which increases the muscles ability to metabolise carbohydrates and fat
- Maximised aerobic potential muscle fibres
- A trained individual will have a greater proportion of slow twitch muscle fibres

Training and the Lactate System

Changes in this system are related to changes in the cardiorespiratory system. Muscles that receive and utilise more oxygen produce less lactic acid at given intensities. Regular anaerobic training improves the tolerance to lactic acid build up – targeted interval training at higher intensities tend to improve the body's ability to tolerate the build-up of lactic acid (lactate tolerance) and/or the ability to remove it more quickly, leading to a delay or prevention of the accumulation.

Training and the CP System

Activities emphasizing the CP system (heavy weightlifting and sprinting) increase muscle mass and fast twitch muscle fibres. It can also increase the muscular stores of anaerobic fuel sources (ATP, creatine phosphate and glycogen) and improve the activation of the muscle by the nervous system

Interaction of the Energy Systems

All 3 systems provide the body with energy simultaneously, but the proportion of their contribution changes depending on the demands of the exercise. As the demands of the exercise change so does the relative contributions of the energy systems.

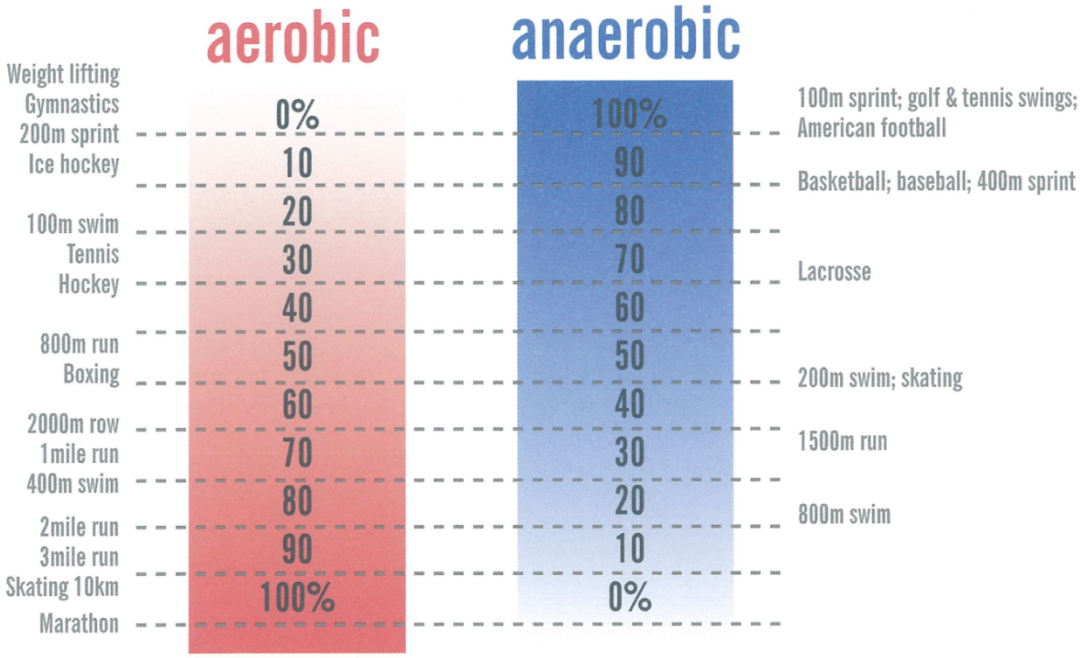
Muscle cell burns off the ATP they already have in 3 seconds

ATP-PCr system kicks in for 8-10 seconds

If exercise continues longer, lactic acid energy system kicks in for 60-90 seconds

If exercise continues the aerobic energy system take over

CP system	Lactate system	Aerobic system
Anaerobic	Anaerobic	Aerobic
Very rapid	Rapid	Slow
Chemical energy	Glycogen	Glycogen and fat
Very limited ATP	Limited ATP	Unlimited ATP
No fatiguing waste products (creatine is recycled)	Lactic acid Fatiguing by-product (lactic acid)	No fatiguing waste products (carbon dioxide and water)
Short duration (0-10 seconds)	1-3 minutes of intense activity	Long duration
Very high intensity (95-100% max effort)	High intensity (75-85% max effort)	Low to moderate intensity (up to 75% max effort)
Quick recovery (30 seconds-5 minutes)	20 minutes-2 hours (breakdown of lactic acid)	Time to eat and drink (to replenish fuel stores)
Type 2b	Type 2a and 2b	Type 1 and 2a



Section 8: The Endocrine System

Hormones play a vitally important role in the body. This section will aim to cover how a hormone functions, the major endocrine glands and their location and the key hormones in health and exercise.

The Endocrine System

The endocrine system helps maintain homeostasis along with the nervous system. It uses hormones (chemical messengers) produced by glands and secreted into the bloodstream. Hormones are chemical messengers that help control and manage the body's internal environment. They could be seen as the 'key' to a specific 'lock' on the binding site of a target cell. Different hormones have different chemical shapes which determine the effect it will have so the binding action 'unlocks' the cell and causes the desired response.

How Hormones Work

Endocrine function can be summarised as:

↓

Endocrine gland receives stimulus

↓

Gland releases chemical hormone

↓

Hormone travels in bloodstream

↓

Hormone receieved by target cell receptors

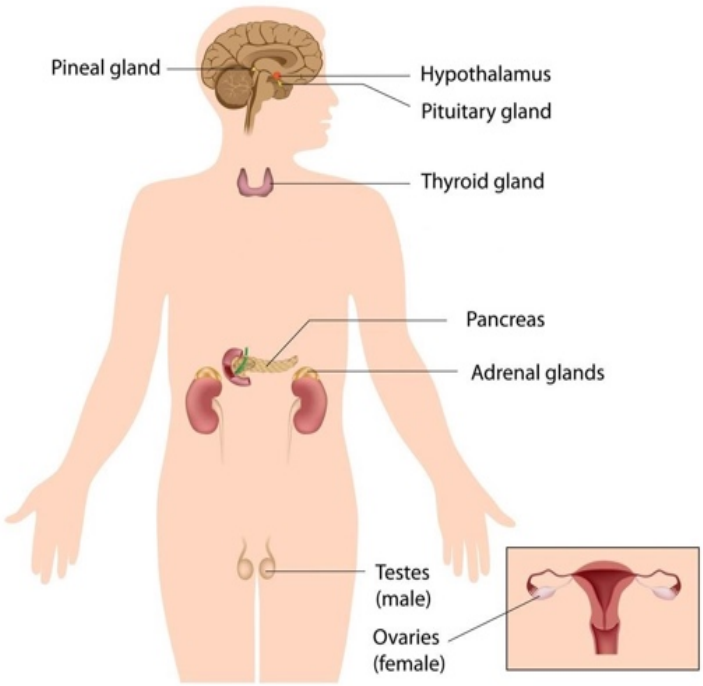
↓

Cell stimulated to cause desired response

↓

Feedback to the originating gland

The process starts when an endocrine gland receives a stimulus that requires a response. A specialised chemical (hormone) is then released into the bloodstream to look for its specific target cell. Each type of hormone is attracted to specific receptors in target cells which can only be triggered by the right hormone (like a lock and key). Once the hormone reaches the target cell it docks at the receptor site and initiates the desired response. When the hormone response has the desired effect a feedback loop between the target tissue and the endocrine gland will reduce or stop the hormone production.



Major Endocrine Glands

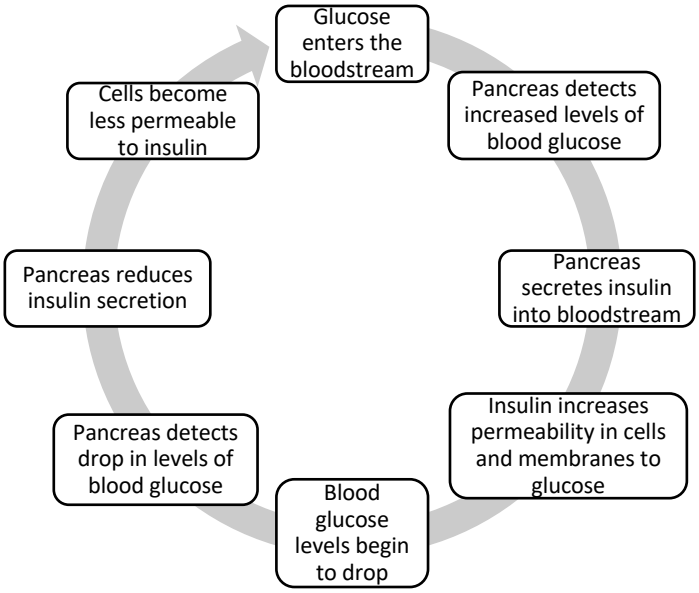
The endocrine system and its functions are governed by specialised glands that are scattered throughout the body. They produce the hormones that maintain the delicate internal balance.

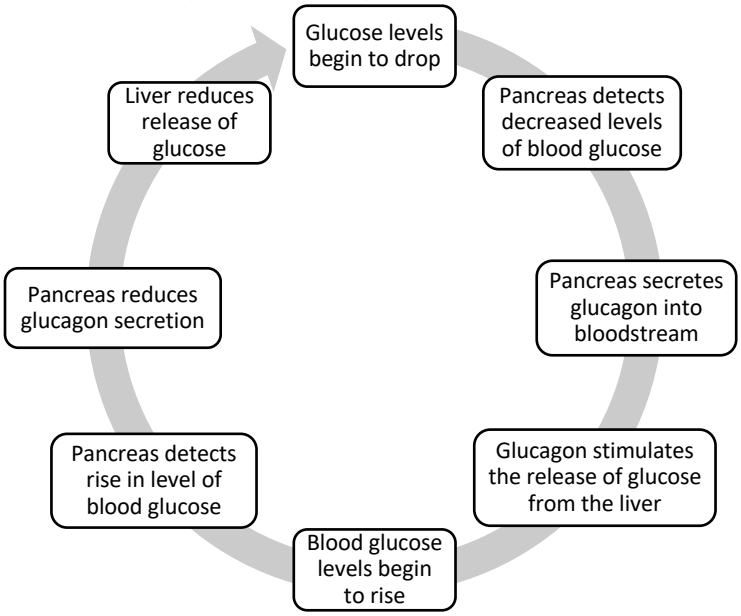
Pituitary gland	•Considered the master gland as most endocrine outputs originate from here
Thyroid gland	•Considered the master regulator of metabolism
Adrenal glands	•Named after their location on top of the renals (kidneys) and help to control/ manage the stress response
Pancreas	•Sits below the stomach and helps to control carbohydrate metabolism
Ovaries	•Located in the female lower abdomen either side of the uterus – responsible for numerous functions of female sexuality
Testes	•Located in the scrotum and are responsible for numerous functions of the male sexuality

The Functions of Hormones

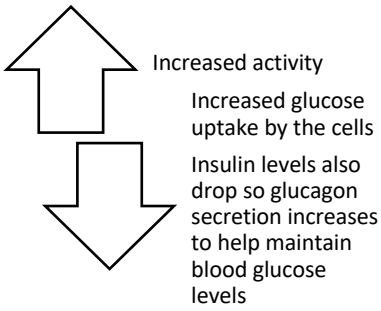
Insulin and Glucagon

The pancreas is responsible for producing 2 counterbalancing hormones – insulin and glucagon, which regulate glucose levels. When a carbohydrate is consumed and digested it is broken down into glucose where it is absorbed by the bloodstream. When blood glucose rises the pancreas knows to secrete insulin, which travels to target tissues and signals for cellular channels to open to allow glucose to be moved from the blood into the cell where it can be used. Blood glucose then returns to normal levels. (See diagram on the right)





After a long period without food or with prolonged activity, glucose levels may drop below optimal. This time the pancreas secretes glucagon which stimulates the liver to break down glycogen which helps to restore blood glucose to a more acceptable level. (See diagram on the left). The effect of exercise can be seen in the diagram to the right:



Testosterone and Oestrogen

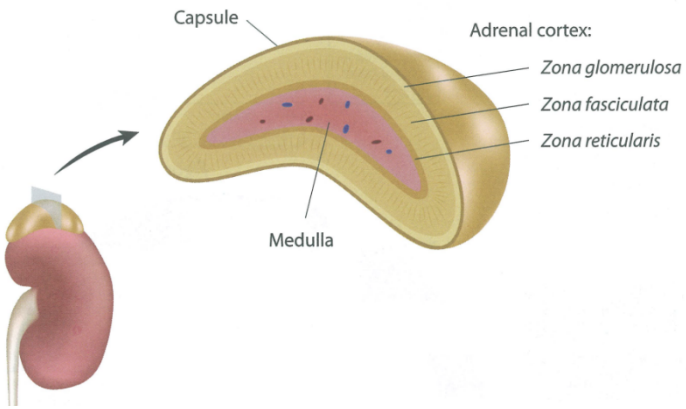
The sexual glands in both males and females release hormones that cause physical changes during puberty and health during adulthood. They control key functions associated with growth, repair and storage in the body. In females the ovaries release oestrogen and in males the testes release testosterone. Testosterone (males and females) helps to stimulate the growth of muscle tissue. Males produce up to 10 x more than females and is responsible for facial and body hair growth and greater muscle mass. Oestrogen helps to influence the storage of fat around the hips, buttocks and thighs. Women of a reproductive age have higher levels than men which are responsible for breast development and regulating the menstrual cycle.

Catecholamines and Corticosteroids

On top of the kidneys are small glands called adrenals which are divided into an inner and outer layer

- Inner layer (adrenal medulla) produces catecholamines
- Outer layer (adrenal cortex) produces corticosteroids

They are well located on top of the kidneys as they have a direct link to the major blood vessels of the body – meaning the hormones can be circulated and have an effect very quickly.

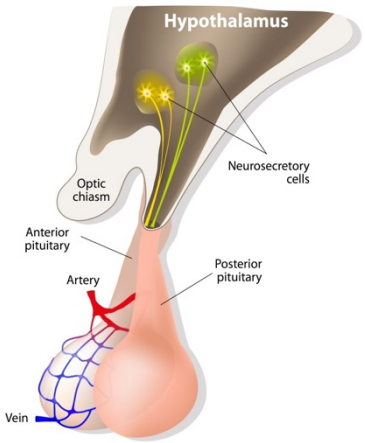


The most well-known catecholamine is adrenaline. Adrenaline and nor-adrenaline are released from the adrenal medulla when a 'fight or flight' response is needed. They are the hormones of action and cause an increased heart rate, blood flow and breathing and alertness levels in order to rapidly prepare the body for action.

Cortisol is the main corticosteroid released from the adrenal cortex which helps to provide reserves for dealing with stress. Cortisol, often referred to as the 'stress hormone', is catabolic and breaks down carbohydrates and fats to provide energy for the body during stressful periods. In long-term chronic stress, the excess cortisol can lead to a deterioration in health due to an imbalance in the endocrine system. Aldosterone is another corticosteroid released from the adrenal cortex which helps to regulate and balance, sodium and potassium in the bloodstream – maintain the water balance in the blood.

Growth Hormone

Growth hormone (GH) is directly released by the pituitary gland and is an anabolic hormone that promotes growth – particularly bone growth during puberty and protein synthesis in muscle tissue. It helps to break down and release fat tissue from storage sites around the body for oxidation.



Thyroid Hormones

Thyroid hormones are released from the thyroid gland in the upper chest – although secretions from the pituitary gland stimulate the release from the thyroid gland. Thyroid hormones are responsible for human metabolism and help regulate the use of oxygen in cellular energy production, the maintenance of body temperature and overall metabolic rate.

Both hormones influence how the body works to maintain good health so it is vital they are kept at the correct levels. Low thyroid function can lead to low metabolism, fatigue, depression, sensitivity to cold and weight gain.

Section 9: The Lymphatic System

The lymphatic system is part of the vascular system and has three major functions.

1. Absorb lipids from the small intestines
2. Return tissue fluid to our bloodstreams
3. Filter fluid to prevent infection of the blood and tissues.

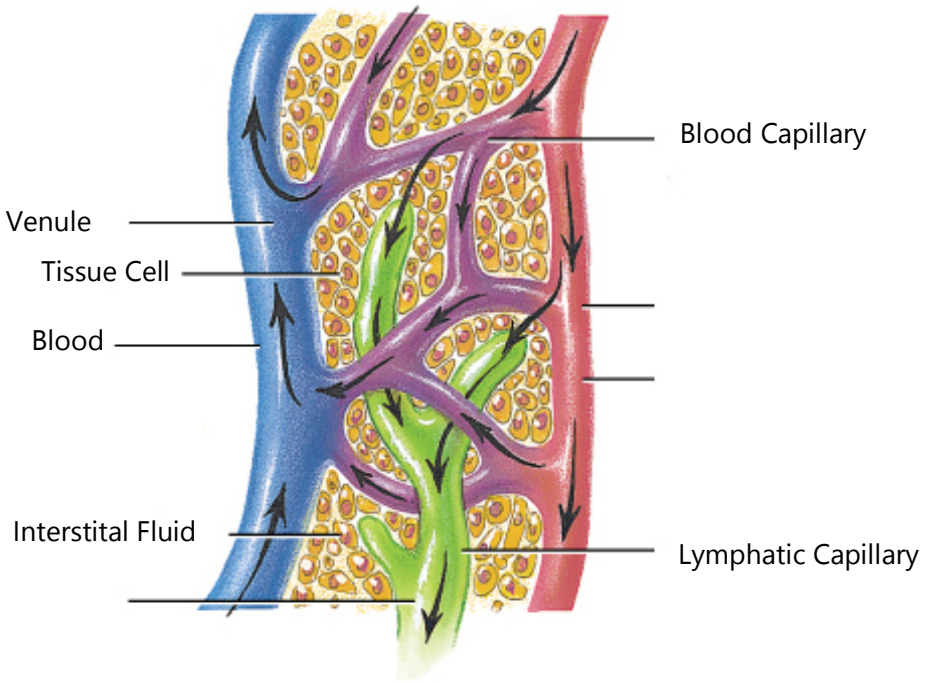
It is an essential system for helping to prevent and reduce oedema, maintain blood viscosity and vascular homeostasis.

The lymphatic system is an interconnected organisation of spaces and vessels between cells in the body's connective tissues and the specialised organs (bone marrow, thymus, spleen, lymph nodes, tonsils, and diffuse and nodular lymphatic tissues), through which lymph circulates throughout the body.

Its functions include transport of absorbed lipids from the meals, the return of excess extracellular/interstitial fluid to the cardiovascular system, and a variety of immune defence functions.

Lymph flow is regulated by gravity, interstitial fluid, hydrostatic pressure, the muscular pump in the limbs, the thoracic pump in the chest, and valves which prevent backflow.

Location of the lymphatic capillaries



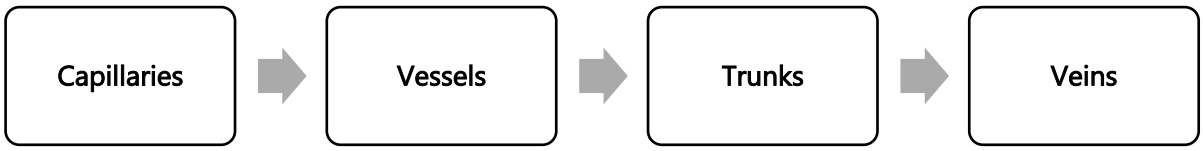
Structure of lymphatic Capillaries

The smallest lymph vessels, lymph capillaries, are blind ended and have tiny 'flap-like' non-return valves along their length. As tissue fluid around cells increases, pressure opens the flap-like valves and it enters the lymphatic system and is known as lymph.

This opening is large enough to allow large molecules, bacteria, viruses and other waste products to enter the system.

Passage of Lymph

Once tissue fluid passes into the lymphatic system (lymph) it passes through a network of gradually increasing vessels in exactly the same manner as that of venous return.



Lymph returns to the bloodstream via two ducts into the subclavian veins:

- Right lymphatic duct.
- Thoracic duct.

Lymph passage through the systems

Lymphatic circulation is not a 'pump' like the arteries, but works in a similar way to veins using the following means to move lymph through the lymphatic vessels:

- Peristalsis of smooth muscle walls of the vessels.
- Pumping from skeletal muscles.
- Suction from the diaphragm.
- Non-return valves.
- Gravity.

Lymph contains many waste products and pathogens that need to be removed before it can re-entre the blood vascular system.

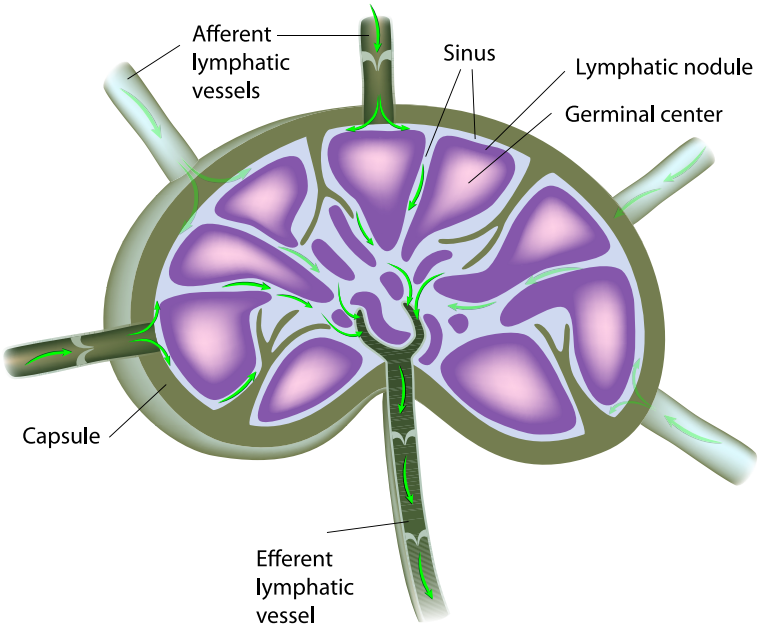
Lymph nodes are small bean-shaped structures in which pathogens, old cells and other waste products are neutralised and processed. Lymph nodes produce lymphocytes that fight infection by destroying pathogens such as bacteria, playing an important role in the immune system.

Structure of Lymph Nodes

Lymph nodes are made by reticular and lymphatic tissues containing mainly lymphocytes and macrophages and range in size, from 2 to 10mm. They are spherical in shape and are encapsulated by a fibrous capsule which dips down into the node to form a partition called a trabeculae.

Under the capsule sits the subcapsular sinus, the cortex, a paracortical region and a medulla. The cortex contains follicles and when stimulated becomes enlarged with germinal centres. Those follicles are comprised of B cells and follicular dendritic cells.
The paracortical region is thymus dependent and contains large numbers of T cells interspersed with interdigitating cells.

Each lymph node has 4-5 afferent vessels that bring lymph to the node, and one efferent vessel draining the lymph away from the node. A concave surface called the hilum is where an artery enters and a vein and the efferent lymph vessel leave.
Depending on the position of the lymph node they may be superficial or deep.



Effects of Massage on the Lymphatic System

A massage will mechanically stimulate the ducts and lymph flow to improve the circulation of lymph.

Research has also suggested that massage helps increase the number of lymphocytes (white blood cells) and therefore the ability to fight disease.

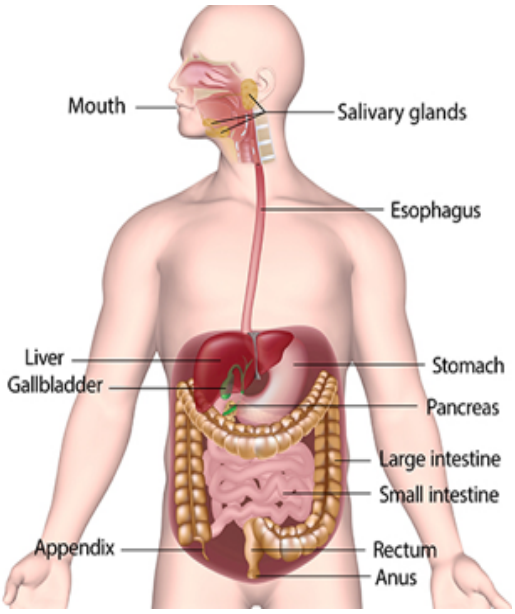
Section 10: The Digestive System

The digestive system includes the digestive tract and has some accessory organs which help to process the food we ingest into molecules that can be absorbed and utilised by cells of the body. The digestive system includes the mouth, salivary glands, oesophagus, Liver, Gallbladder, stomach, pancreas, large Intestine, small Intestine.

The digestive system has four stages:

Ingestion	The food that we ingest.
Digestion	The breaking down of the food we have ingested through chemical processes.
Absorption	The absorption is the passing through to the blood stream to be delivered to the body's tissues which takes place mostly in the small intestine.
Secretion	The removal of waste product.

The Journey Through the Digestive Tract



Mouth
- Is the beginning of the digestive system and the point which begins to break down the food through the process of chewing.

Esophagus
- The tube that carries the broken down food from the mouth to the stomach. (UK spelling - Oesophagus)

Stomach
- Is located just below the diaphragm. It contains enzymes that break down the food to begin the process of absorption and kills bacteria.

Small Intestine
- A series of small tightly fitted tubes structures that receives broken down food from the stomach and absorbs nutrients into the blood stream to be delivered and used by the body's cells.

Large Intestine
- Absorbs water, vitamins and minerals. Contains bacteria to help prevent infections. Also contains the rectum and anus which store and secrete waste.

Dietary Fibre

Recently agreed by the European Commission that dietary fibre also makes a small contribution to energy as it is digested in the large bowel by the resident bacteria. An energy value of 2kcal/ per gram has been attributed to this. The majority of Fibre stays in the digestive system to provide a smooth passage throughout helping reduce cholesterol maintain a healthy bowel preventing diseases such as heart disease and bowl cancer.

Breakdown and absorption of Food

Carbohydrate	Digested and broken into Glycogen and Glucose	Used for energy
Fats	Digested and broken into Fatty Acids and Glycerol	Used for Energy and Insulation
Protein	Digested and broken into Peptides and amino acids	Repair and Growth of bodies tissues

The Role of the Liver and Pancreas in Digestion

Liver

The liver is largest of the bodies internal organs and helps with digestion and absorption of food by secreting bile which assists the breakdown of fats in the small intestines. It also assists in the storage of vitamins and minerals and removal of bacteria from the bloodstream.

Pancreas

The pancreas is important to the digestive system, it secrets digestive fluids into the small intestine which contain the enzymes which are responsible for the breakdown of nutrients.

Functions of the Digestive System

Excretion

The digestive system removes potentially poisonous substances that are the end products from metabolism. The main organs involved are the kidneys and large intestines, which remove urine and solid/ semi-solid waste respectively.

Absorption

Absorption is the movement of food into the tissues and blood. The process occurs in the small intestine via the villi, projections from the small intestine, which provide a surface for absorption to take place. Each villi has capillaries that quickly absorb nutrients into the blood stream and tissues.

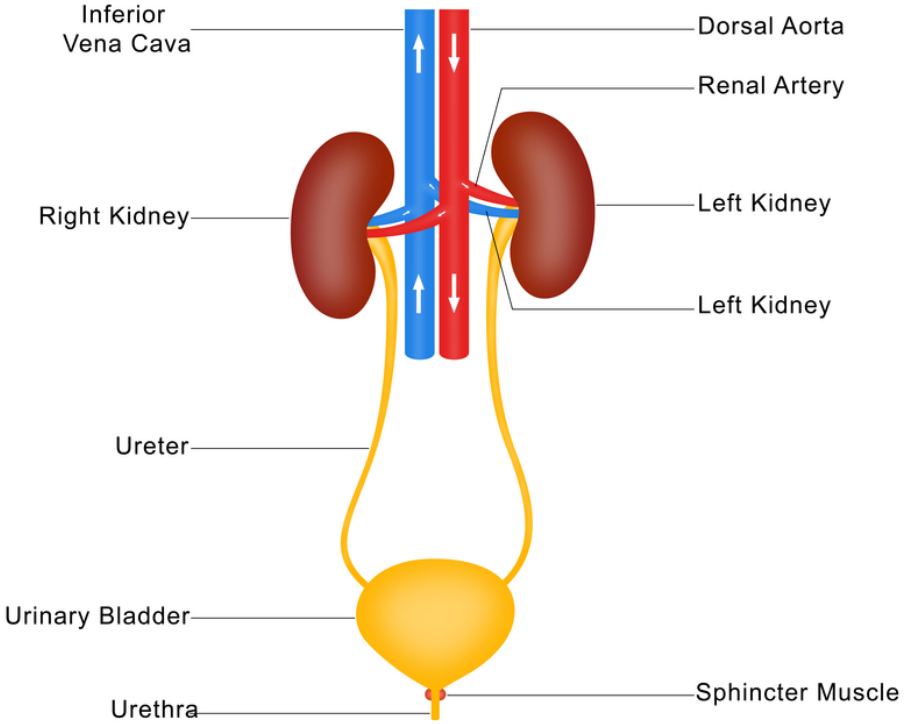
Digestion

Digestion is a multi-stage process following the ingestion of raw materials (food) and involves both mechanical (buccal cavity/mouth) and chemical (enzymes) aspects. The body is unable to use large pieces of food so it must digest to break them down, to absorb and transport them. Carbohydrates, proteins and fats are digested and absorbed as sugars, amino acids and fatty acids.

The Effect of Massage

The digestive system is indirectly affected by massage. Massage can be very soothing and relieve unwanted pain and stress, so it is important to remember the connection between the autonomic nervous system activity and the digestive systems. For some digestive conditions linked to stress a massage can improve digestive functioning by decreasing sympathetic nervous system activity.

Section 11: The Urinary System



The urinary system is also known as the renal system. The system consists of the following structures:

- Ureters
- bladder
- kidneys
- urethra.

The main functions are to remove waste within the body, however it also has several other functions. Other important functions of the kidneys include blood pressure regulation and the production of erythropoietin, which controls red blood cell production in the bone marrow.

The kidneys make urine by filtering waste and extra water from the blood. Urine travels from the kidneys through two thin tubes called ureters and fills the bladder. When the bladder is full, a person urinates through the urethra to eliminate the waste. The kidney and urinary systems help the body to eliminate liquid waste called urea, and to keep elements such as potassium and sodium, and water in balance.

Section 12: The Effects of Sports Massage on the Body Systems

Sports massage is the manipulation soft tissue and a highly effective tool for removing waste products such as lactic acid. As a physical therapy sports massage can have many effects on the body. This includes:

- Physical.
- Physiological.
- Neurological.
- Psychological.

Sports massage can be used in three different ways. It can help aid recovery, may enhance performance and prevent an injury. Sports massage has several applications for each of these uses and can be applied for pre and post event or for maintenance massages.

Pre-event massage requires a slightly lighter than a post treatment or maintenance sports massage. Its main aim is to ease any tension, promote circulation and improve elasticity of the muscle fibres, ready for performance. By promoting heat, the pliability of the muscles is increased.

Maintenance massages maintain muscle length, ensure muscle fibres free from adhesions and improve range of movement. Relieving any built-up tension can help to maintain neutral posture. Sitting at a desk for 8 hours a day for example can have a negative effect on posture and cause some muscles to shorten and develop adhesions, becoming painful with a reduced movement.

A post event treatment starts the recovery process. It helps the body to flush out waste products that have been produced from exercise, helping to promote recovery and repair damaged fibres by aiding circulation of nutrient rich blood flow to the muscles. An important benefit of sports massage is also relaxation; this can help promote a positive mind set, aid mental recovery and be ready for the next event.

Summary of Benefits

Recovery	Helping to promote the dispersal and disposal of waste products therefore aiding the body to recover quicker and feel better.
Reducing pain	Making muscles feel warm and pliable, releasing 'feel good' endorphins. The 'pain gate' theory suggests when we feel pain we automatically rub the area to create impulses that 'close the gate', therefore reducing the signals that reach the brain. The results are replicated with the application of sports massage and helps inhibit pain signals.
Injury Prevention	Pre event massage aids the warm up process by promoting blood flow and warming the muscles making them pliable and more able to move through a full range of movement. Regularly scheduled sports massages can help reduce the likelihood of the muscles becoming overworked and can also help reduce the initial damage & inflammation that leads to the injury. In general the same group of muscles will be used within an event/game and therefore they will become injured and overused, making them like a solid mass.

Physiological Effects

A treatment can give a sympathetic or parasympathetic effect on a client's body depending on how it is applied and in what circumstance.
For the majority, the parasympathetic or relaxation response is more desirable as it brings the following benefits:

- Reduced production of sympathetic or 'stress' hormones
- Vasodilation to the blood and the lymphatic vessels, caused by the relaxation of the smooth muscle
- Reduced neural stimulation (contraction) of muscles due to the relaxation of the skeletal muscles

Psychological Effects

Following a sports massage, a client will also experience psychological effects which are linked to the physiological effects.

A vigorous massage will have a sympathetic effect, increasing the production of adrenaline and endorphins in the client's body and stimulating their mental and physical states. It will also help improve body awareness by improving the nervous system function.

However, a massage that engenders a parasympathetic response should release tension within the tissues and reduce blood pressure, cause the client to feel more relaxed and less stressed. Lowering pain in the process. This is done by stimulating the cutaneous mechanoreceptors that block the signals before they reach the spinal cord. As a result of the body not receiving those pain signals the perception of the pain is reduced.

It is important to be aware that the physical and mental responses of receiving a sports massage are closely linked. This means that the end result can be influenced by the client's state of mind and by what they are told to expect from the massage.

Physical Effects

As sports massage tends to include the pumping, squeezing and stretching of soft tissue it can result in a variety of physical effects which can be defined as a mechanical effect.

This includes the improved flow of blood, lymph and other fluids, and the better mobility of soft tissue. Certain massage techniques can lead to the separation of muscle fibres from one another or from other soft tissue.

The Benefits of Sports Massage

The benefits of massage range from overall wellbeing to specific benefits, which stem from improved circulation as well as the relaxation and mobilisation of soft tissue. This can include:

- Better recovery from physical activity as metabolic waste products are removed from the tissues
- Improves sleep patterns
- Improved healing and repair as more nutrients are supplied to vascular tissues
- Relief of pressure from congestion and metabolic irritants and the reduction of tension in the muscles can all help reduce pain
- Better range and efficiency of movement, which will reduce the risk of injury
- Improved posture and awareness of how the client positions themselves
- Fewer impairments to muscular function

Unit Summary

To understand all the effects of sports massage it is important to comprehend the different systems and how they are linked.

Sports massage causes multiple effects in many areas within the body and the mind, so using a range of different techniques can stimulate physiological, psychological and physical changes.

Unit 2 Principles of Exercise Fitness and Health

Aim

To provide instructors with a basic level knowledge of the principles of health and fitness in order to understand and be able to prescribe safe and effective exercise.

Outcomes

- Be able to describe the components of fitness
- Be able to describe the health benefits of exercise
- Comprehend the effects of exercise on the body
- Explain the principles and variables of fitness to an exercise program
- Identify the contraindications to exercise and key safety guidelines for selected special population groups

Unit Contents

Components of Fitness

Exercise is structured activity that requires physical effort with the aim of sustaining or improving physical fitness (Ekkekakis and Lind,2006). This can include wide varieties of activities that can be manipulated to achieve specific outcomes related to fitness goals or improve specific components of fitness described as frequency intensity time and type (FIIT).

- F •Frequency of training. How often an individual will train.
- I •Intensity of training. How hard the individual will work.
- T •Time or duration of training. How long individual sessions will last.
- T •Type of training. Specific training modality used to acheive desired outcome and goal.

Physical fitness is a state of wellbeing that provides optimal performance (Robergs and Roberts 1997). Being physically fit is described as an individual's ability to perform exercise requiring different components of fitness, which are spilt into health related and skill related components.

Health Related	Skill Related
Cardiovascular Fitness: The ability of the body to take in, transport and utilise oxygen during exercise. The greater the ability the fitter a person will be.	Speed: Is quickness and pace of movements. This can be developed but limited to genetics and dominance of muscle fibre type.
Muscular Endurance: The ability of the muscles to generate low levels of force for an extended period of time.	Power: The ability to exert maximal force as quickly as possible i.e. explosive vert Jump. Note not to be confused with strength which is the maximal amount of force a muscle can exert on against a weighted object i.e. Heavy Back Squat.
Muscular Strength: The ability of the muscles to exert maximal force against a weighted object.	Reaction Time: The ability to respond quickly to a stimulus is reaction time. i.e. a starters pistol in a race.
Flexibility: Is the range of movement a person has at a joint or series of joints.	Co-ordination: The ability to link or move two or more body parts under control smoothly and efficiently to achieve a desired outcome.
Body Composition: Is the proportion of the body that is fat and fat free mass.	Balance: The ability to keep centre of mass over the base of support. To stay upright or in control of movement.

Agility: The ability to rapidly change direction or position of the body.

To design effective exercise programmes Instructors must have a good understanding of the concepts and components of fitness. Combined with knowledge of anatomy and physiology, this will allow them to produce programs that are appropriate for their participants' needs, goals and current ability.

Factors Affecting Health and Fitness

Age	The effects of exercise are different during various stages of a lifetime. Peak fitness occurs generally mid-twenties to early thirties. For older adults muscles become weaker, joints become warn and hormone levels decline.
Gender	The differences in fitness occurs between male and female due to the physiological differences. Greater testosterone levels, larger stronger frames, greater strength levels, and generally lower body composition are all characteristics of being male.
Activity Level	Inactive and sedentary people face increased risk of disease. Simple exercise methods such as walking, cycling and gardening can make a sufficient difference to this population.
Diet /Nutritional Intake	Diet is as an important aspect of physical activity. A healthy balanced diet will contribute towards training for increased fitness levels, decreased body composition levels and decreased risk of disease and obesity.
Physical Impairment	Physical impairment may prevent a specific aspect of training or the body from functioning as required but exercise can be adapted to enable participation.
Stress	Stress can have a big impact on health leading to medical conditions such as high blood pressure and heart disease. Exercise will have a positive effect on a person's wellbeing.
Environment	Weather and temperature conditions will have an effect on exercise habits and poor weather conditions could be used as a reason not exercise.
Pregnancy	Significant changes to the female body should be met with adapted exercise regimes from an appropriately qualified instructor.
Heredity	Physical appearance, body type, training potential and body type are all influenced by genetics and inherited from their parents.

Body Types	• Ectomorphs naturally have a light build minimal bodyfat or muscle mass. Find it difficult to gain muscle or fat. More suited to endurance events. • Mesomorphs have large bone structure. Lean and muscular, most suited to athletic events requiring high levels of skill related fitness. • Endomorphs and prone to higher percentages of bodyfat. Must be more mindful of calorie consumption. Most likely to have a pear shaped physique.

Principles of Training

The key principles of training ensure individuals continue to progress towards their goals in a safe and effective manner, with a number of variables are taken into account.

Principles of Training	
Individuality	Training programmes need to be designed to suit the individual and a number of factors taken into account, age, gender, training experience and skill level, current fitness levels, any contraindications and individual goals.
Specificity	Specificity relates to an individual's goals and which component of fitness will help them to achieve them.
Progressive Overload	Progressive overload is to continually challenge the body to adapt to a new stimulus. This can be achieved in a number of ways and is dependent on current levels of fitness and individual goals. • Increase frequency of sessions • Increase duration of sessions • Increase load • Increase repetitions and number of sets • Increase speed • Decrease rest periods The changes needed will be dependent on the individuals current level of fitness. Deconditioned participants will only need minor changes to elicit the required effect whereas an experienced trainer may need greater overload.
Adaptability	The body will adapt to the training stimulus and style of training used and progressive overload applied i.e. Low reps, high weight, high intensity will lead to gains in strength.

Recovery time	Physiological adaptations occur after the exercise sessions and are assisted by adequate rest and recovery. Sleep, good nutritional habits according to stimulus of training and adequate water intake will enhance the adaptations achieved. Rest and recovery are also an important part of avoiding over training.
Reversibility	Use it or lose it. The rate of decline will be dependent on an individual's current level of fitness and body composition and the length of time that the body is not placed under stimulus or stress.

To improve a person's physical fitness the training plan has to be structured with a purpose and goal specific to the desired outcome. Programming for health can be achieved through being physically active on a daily basis to include walking, cycling, vigorous gardening or housework and other non-exercise activities.

The Benefits of Exercise

There are huge benefits to leading a healthy lifestyle and taking part in physical activity. It will help in prevention, reduction or in some cases cessation of chronic illness and diseases.

Other health benefits to exercise but not limited to:

- Weight management.
- Reduced risk of cancers.
- Regulation of hormones.
- Improved bone density.
- Reduced risk of falls.
- Reduced risk of heart disease.
- Regulation of blood sugar, insulin and blood pressure.
- Improved mental health.
- Improved strength of muscles.
- Increased life expectancy.

Delayed Onset Muscle Soreness (DOMS)

Delayed onset muscle soreness is the pain and stiffness felt in the muscles normally between 24-48 hours after the intense exercise and on occasion can be known to last up to 72 hours.

The mechanism is unknown but it is thought that DOMS is created from the micro tears that are created in the muscles during the session. Following a period of good nutrition, hydration and recovery these fibres will grow back bigger and stronger as supercompensation for the session.

DOMS is most likely to be caused from new or intense resistance sessions, particularly slow controlled eccentric movements that will cause more micro tears to muscles fibres.

Special Populations

Working with special populations requires further education and qualifications to ensure that the specific needs of each type of special population is understood fully, and instructors are able to offer safe and effective guidance.

Gym instructors are required to have an understanding of the basic guidelines and the life-course of the musculoskeletal system but not work with these populations on a long term basis until suitably qualified.

Young People

Muscle mass steadily increases during childhood from 25% of body weight at birth to 40% by adulthood. During puberty young people experience an increase in hormones which results in an increase in muscle mass particularly in males.

During a young person's maturation they will experience a growth spurt, during which bones grow at a rapid rate. This occurs at different rates and ages but commonly 12-13 ending at 18 for females and 14-15 ending at 20 for males.

During growth spurts, cartilage is vulnerable to trauma and overuse. Growth plates see new bone growth near the proximal ends of bones (epiphyses) and are the weakest area of a growing skeleton. Growth plate fractures are most common in boys aged 14 – 16 year olds and girls aged 11 – 13 years old.

During the growth spurt soft tissue around the joints is already stretched as muscle growth doesn't match bone growth.

Playing too much sport at a young age, particularly at a high level requiring intense training and competition can cause fractures. Preventive measures can be taken by incorporating thorough warmups, limiting high intensity and carrying out thorough cool downs, stretching only to a point of mild tension avoid repetitive heavy lifting and high impact movements.

Young people taking part in regular training programmes is common practice and should be guided with the understanding of the physiological and psychological changes as they progress through their teenage years. Young people require close supervision to ensure they have correct alignment of the body during exercises and need to be coached to develop good body awareness and motor skills which in turn will develop good technique. Young people also have an inferior cooling systems are very sensitive to heat stress so regular water breaks should be implemented.

Pre and Post Natal

Maintaining modified physical activity is recommended for healthy pregnant women. The PARmedX exercise screening method should always be completed to identify any contraindications or reasons for a referral to specialist instructors. Guidance given relates to normal, healthy adult women experiencing a normal healthy pregnancy who had a healthy birth. Women will experience changes such as reduced joint stability, weaker pelvic floor muscles, lengthened and weaker abdominal muscles and postural changes.

Relative Contraindications – Exercise can be Undertaken with Precaution and Modification

- Previously sedentary
- Growth restriction in current pregnancy
- Skeletal issues and limitations
- Seizure disorder
- Hyperthyroidism
- Smoking
- Severe anaemia
- Diabetes
- Obesity
- Underweight

Absolute Contradictions – Referral to GP

- Heart disease
- Lung disease
- Incompetent cervix
- Risk of Premature delivery
- Persistent bleeding
- Placenta previa after 26 weeks into pregnancy
- Preeclampsia

Pre Natal Adaptations to Exercise

Pregnant women should avoid:

- Exercising in the supine position after 16 weeks
- Look to exercise to any sort of exhaustion. Goal is to maintain physical activity
- Prone lying exercises
- Prolonged motionless standing
- Heavy resistance work
- Isometric exercise
- Forward flexion exercises
- Quick changes of direction twisting turning
- Unbalanced exercises
- Abdominal exercises

Post Natal Adaptations to Exercise

Women should avoid exercising post birth until they have received permission from a healthcare professional at a post-partum check-up.

The goal immediately post exercise is to re-train good posture, joint alignment muscular imbalances and to make improvements to stability and motor skills.

A referral should be made if a post-natal women is experiencing:

- Stress Incontinence or pelvic floor weakness
- Heaviness to lower abdominal or pelvic floor area
- Lower back or pelvic pain
- Abdominal weakness, doming or separation.

Older Adults

Defined as over the Age of 65 or over the age of 55 with at least 1 clinically significant health condition or physical impairment (ACSM).

The ageing process is associated with progressive loss of function and skeletal issues that experience progressive loss of bone mass called osteopenia which may progress to osteoporosis. As people age, most will experience a reduction in joint range of motion and postural changes that will affect movement capabilities along with cardiovascular capacity. These progressive issues will require adaptation to meet any individual needs.

Physical Activity Guidelines for Older Adults

Session content	Consideration
Warm up	• Extended warm up • Larger emphasis on mobility exercises • Gradual increase of ROM • Slow controlled movements • Focus on technical ability posture and alignment
Cardiovascular	• Gradual increase in intensity • Low impact, Simple controlled movements
Resistance Training	• Weight baring exercises will increase the strength of bones and reduce risk of bone related disease. • Modify sets, reps, duration, Increased recovery periods • Focus on technical ability posture and alignment • Have full awareness of any osteoporosis or spinal issues

	• Work to strengthen postural muscles, pelvic floor and surrounding areas
Cool down	• Longer duration • Stable positions for stretches • Simple easy to achieve stretches • Decreased range of motion.

Disabled People

Regular physical activity can help promote, maintain and improve independence for disabled people. In a safe and supportive environment it can also be an important factor of reducing the risk of chronic health conditions.

Instructors can promote and encourage physical activity to disabled people that wish to access fitness facilities and facilities can reduce any access related barriers.

Instructors should offer to help disabled people follow basic guidelines to training with adaptations when considering exercise selection, teaching style to suit participants needs and with the upmost awareness to their health and safety.

Effect and Health Benefits of Physical Activity on Contraindications

Physical activity can act as a preventive measure on many of the modifiable factors that contribute to disease. Reduces the risk of obesity, maintains optimal blood pressure, cholesterol levels, stress and stress management.

Disease	Benefits of Exercise
Heart Disease	• Reduces overall risk
Cancer	• Reduces overall risk
Diabetes	• Provides a preventive effect • Reduces risk of developing type 2 diabetes • Improves insulin sensitivity • Assists in weight management
Hypertension	• Helps to reduce or normalise hypertension issues • Helps with weight management which in turn will help reduce hypertension
Obesity	• Offers a preventive measure • Assists in weight management and reduction • Reduces risk of other CVD diseases
Osteoporosis	• Help reduce bone loss • Improve Strength, co-ordination and balance reducing risk of falls

Unit 3: The Principles of Soft Tissue Dysfunction

Aim

The aim of this unit is to provide learners with the knowledge and understanding of treatments to support soft tissue repair.

Outcomes

Describe common types and causes of soft tissue injury
Distinguish injury severity
Differentiate between soft tissue injury and dysfunction
Describe the stages of soft tissue repair
Explain the importance of the inflammatory response and process

Section 1: Underpinning Principles of Soft Tissue Dysfunction

To move and function effectively it is vital that all soft tissue is functioning at its optimum level. Any injury or impaired function will affect your movement patterns and performance.

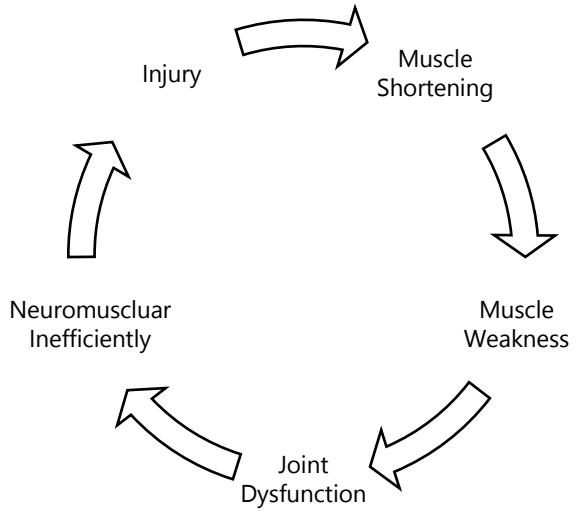
Soft tissue dysfunction is common following sprain/strain type injuries, with muscle spasm, postural syndromes, from repetitive use, or after improper tissue healing. It is essential that sports massage therapists understand how to plan and treat dysfunctional tissue to ensure that clients have reduced pain and improved mobility. Therapists also need to act within their competencies and know when to refer clients to more qualified and specialist professionals such as physiotherapists and doctors.

The Dysfunction and Injury Cycle

The term *'dysfunction'* can be defined as an impairment or abnormality within an individual's soft tissue. It can be painful, tense or present as an ache with varying degrees of severity.

The body is very adept at handling the stresses and demands placed upon it. When those stresses are proportionate and in balance the body will remain as so and maintain optimum levels. Muscles, tendons and ligaments can adapt to gravity, changes of direction and positions whilst being placed under stress in nearly every activity undertaken - often thriving under such conditions.

However, these stresses can have the potential to cause imbalances within the body which given time can cause levels of dysfunction. If these imbalances are not addressed, secondary and more advanced dysfunctions can be caused. For example, if overloaded, a muscle can weaken and shorten causing some changes to an individual's movement patterns, such as a change of running style. This means that the stresses being placed upon the muscles and joints causes unrealistic demands, increasing stress and possible injury.



If an injury is not rehabilitated in the correct manner and the correct movement pattern restored, then this cycle of dysfunction may repeat itself.
Soft tissue dysfunction is a very common occurrence with most people at some point having suffered from it. The frequency and severity of soft tissue dysfunction is personal to each individual and can be due to many factors such as activity levels, type of job, hobbies, resting positions and historic injury. The table below identifies some examples of soft tissue dysfunction.

POSSIBLE CAUSES:	SIGNS AND SYMTPOMS:
Hobbies – high levels of physical demand, new hobby, repetitive movements.	Reported repetitive movement patterns
Poor resting position, such as sleeping or relaxing on sofa watching TV!	Reported stressful or painful positions in both movement and rest
Adhesions	
Work Stress	Adhesions
Poor seated position	Synergistic dominance
Body Composition – lost weight, gained weight etc.	Altered/poor movement technique – such as walking, jogging, exercise.).
Joint Mechanics altered	Poor/imbalanced posture
Poor movement technique. In both walking and exercise.	Reported aches and pains
Imbalanced / poor posture	
Inactivity	
Lifestyle imbalances – movements, psychological stress and demands.	

Many of the presentations listed above may be apparent during a client assessment, often with no clear historic path that caused the dysfunction. One or several things can cause the problem, with secondary effects then occurring. It may be difficult to identify the specific cause of dysfunction, therefore it is important to prioritise.

When carrying out subjective assessment, reported signs or symptoms can be discussed with your client. Some care advice can also be discussed as well as future actions.

During the objective assessment, any signs or symptoms discovered by the therapist can be discussed whilst planning treatment options. If there are multiple objective causes, then they should also be prioritised.

Synergistic Dominance

One common cause and possible sign of soft tissue dysfunction is synergist dominance. Movements and functions are a complex amalgamation of agonists, antagonists, fixators and synergists. If the prime mover (agonist) is not able to perform the specific movement/function, then the body looks for an alternative to carry the load. This usually makes the synergist take over as the prime mover within the movement. As the synergist is not designed to be a prime mover it is less efficient, therefore more susceptible to fatigue and an imbalanced pull on the joints and bone. Over a period of time this causes dysfunctional movement patterns, heightening the risk of injury.

Signs and symptoms of synergistic dominance

- Aches and pains of specific area
- Very quick to fatigue
- Imbalanced movement pattern
- Imbalanced and changed specific movement (mimicked in activity)
- Imbalanced muscular contractions

Adhesions

Adhesions are a type of scar tissue commonly resulting from two soft tissue structures becoming 'stuck together' or adhered. Adhesions affect how muscles contract and function. The more adhesions there are the bigger the dysfunction within the muscle and movement (compensator pattern).

When collagen fibres are laid to repair within the soft tissue, Davis Law (cited by Clark et al, 2008) states that soft tissue models itself along the lines of stress, the fibres will be laid in an irregular pattern, causing a less functional tissue. The irregular formation causes the adhesion and will feel like a small lump.

Injury

An injury is the result of any stress, force or exceeding normal ROM placed upon any of the body structures that it cannot cope with or absorb. This is the case both intrinsic and extrinsic.

It is vital that a sports massage therapist understands the principles of soft tissue dysfunction and injury treatment. enabling amendments or changes to treatment plans to suit the client and not cause or increase the level of damage.

A Primary Injury can be defined as the original incident or trauma. These injuries can then be classified into two categories:

- Intrinsic
- Extrinsic

Intrinsic injuries

These are factors within the body such as weak or shortened muscles that cause the primary injury. They can occur during the activity and for example through overuse.

Some examples of intrinsic injuries:

- Lifting an object and a strain to the lower back
- A strained quadricep (Rectus Femoris) during a football match
- A calve injury during a marathon

Extrinsic injuries

These are forces from outside the body. These can occur intentionally or as an accident and are often grouped into four types:

1. Environmental (Trips or falls. For example a barbell that hasn't been put away.).
2. Human (Taking a hard tackle during a rugby match or a hit in a boxing match.).
3. Implemental (you make an error and drop a shot put on your foot.).
4. Vehicular (Being hit by a car or motorcycle.).

A secondary injury is as a result of or follows the primary injury. This can usually be due to compensatory movements or posture due to the primary injury e.g pain or injury in the calf makes the client use the opposing leg more readily, or historic injury to quadricep group may have changed a individual's running style, thus more pressure of surrounding structures.

Non-consequential Injuries

Injuries that are not directly caused by activity nor sport are classed as non-consequential; however, they will have degrees of interference with participation. It could be a hereditary condition for example in the
pelvis or skeletal structure that does not cause any problem within everyday life, but when activity or sport intensity increases it can affect function.

A sports massage therapist, through appropriate pre and post care can assist with the client's management of this type of injury/condition.

Skin Injuries

Skin injuries are common with most people experiencing them at some point. They include:

Grazes – rubbing against something hard, like gravel.
Cuts – caused when something sharp like a knife or tin lid pierces the skin.
Burns – Caused by heat, friction, radiation, electricity, chemical reaction. Results in redness, blistering of skin and damage to underlying tissues can be common.

Muscle or tendon strains

Muscular injuries are extremely common within sporting activity and often produce pain, dysfunction, and the inability to return to practice or competition.

When a muscle or tendon is put under excessive stress (overload) or stretched beyond normal ROM it can cause a strain or tear. Strains are graded and are treated slightly differently according to their severity. It is good practice for sports massage therapists to understand the differing grades of strains to complement other treatments.

GRADE OF STRAIN	DEGREE OF DAMAGE	SIGNS AND SYMPTOMS TO THERAPIST
GRADE 1	Strain affects only a limited number of fibres, damaging just 5% of fibres within the muscle. There is small decrease in strength and active and passive range of motion. Pain and tenderness are often delayed to the next day. Resisted ROM will only show mild discomfort.	Minimal loss of function and some small indications of discomfort on resisted movement and contraction upon stretching. Very small amounts of inflammation and may be small amounts of redness.
GRADE 2	Strain causes nearly half of muscle fibres to tear. Acute and significant pain is accompanied by swelling and a minor decrease in muscle strength.	More discomfort in both contracting the muscle and resisted movement, perhaps even passive movement. Pain also limits and stops (reported) activity. There may be a small lump where the torn fibres have bunched together. More signs of swelling and heat from injury site.
GRADE 3	Strains represents the complete rupture of the muscle. This means either the tendon is separated from the muscle belly or the muscle belly is actually torn in 2 parts. Severe swelling and pain and a complete loss of function are characteristic of this type of strain.	Pain and also affecting basic function such as walking. Prevents physical activity. Pain upon palpation and unable to carry out resisted ROM (do not perform this)
NB: grade 2 and 3 strains will have to be dealt with by trained professionals. If there is ANY DOUBT YOU MUST REFER TO APPRORIATE PROFESSIONAL.		

Tendinopathies

The term used to describe any type of tendon injury is tendinopathy. These include any micro tears, tears, overuse or degeneration of a tendon. The term tendinopathy is used whenever and even when the inflammatory process has begun within a tendon-based structure.

A tendon injury is a very common type of injury and can often be the result of overuse or over stretching. Like any structure tendons have limits. They are designed to be or have degrees of elasticity, however once this is surpassed then injury can occur.

Tendinitis	After a tendon tear/rupture first happens, the inflammatory process begins. It can subside or develop into a chronic condition which continues to inflame.
Tendinosis	a degeneration of the tendon's collagen in response to chronic overuse; when overuse is continued without giving the tendon time to heal and rest, such as with repetitive strain injury, tendinosis results. Even tiny movements, such as clicking a mouse, can cause tendinosis when done repeatedly

Ligament Sprains

Ligaments are a-vascular. They have a limited blood supply, which means they have a limited supply of 0_2 and nutrients to enable them to recover, healing therefore has a significantly increased time frame. Ligament ruptures can be very serious and in some sports career ending. They compromise the stability of a joint and there is some research to suggest once a complete rupture has occurred (even after surgery) it will never be the same. They are graded in the same way muscles and tendon strains are.

GRADE OF SPRAIN	DEGREE OF DAMAGE	SIGNS AND SYMPTOMS TO THERAPIST
GRADE 1	Stretching or slight tearing of the ligament with mild tenderness, swelling and stiffness. The joint feels stable and it is usually possible to move and weight bear with minimal pain.	Some mild swelling Mild pain on all ROM tests, passive, active. Some discomfort and pain upon palpation Some small loss of function
GRADE 2	A more severe sprain, but incomplete tear with moderate pain, swelling and bruising. Although it feels somewhat stable, the damaged areas are tender to the touch and movement and weight bearing is painful.	Pain upon palpation Pain on all types of ROM testing (don't carry out any resisted under any circumstance.). Swelling and bruising of the area. Highly compromised function and joint laxity.
GRADE 3	This is a complete tear of the affected ligament(s) with severe swelling and bruising. The joint is unstable and weight bearing is likely not possible because the joint gives out and there is intense pain.	Pain and discomfort, loss of function. Lots of swelling and bruising. Some referred (travelled down joint.). Complaint loss of function and joint laxity.
NB: Grade 2 and 3 sprains will have to be dealt with by trained professionals. If there is ANY DOUBT YOU MUST REFER TO APPRORIATE PROFESSIONAL.		

Joint capsule or capsular ligament damage

Damage to these areas are also classed as a sprain. Signs and symptoms of an acute injury in these areas can be very similar to a ligament sprain.

The joint capsule is lined with synovial membrane, which in turn produces synovial fluid. Once the capsule is compromised it can lead to swelling. Any trauma can also cause adhesions, accumulation of fibrous tissue which will lead to lose of movement.

Section 2: Soft Tissue Repair

Repairing soft tissue is a unique and complex process performed by the body. It is vital that Sports Massage Therapists understand each of the three stages involved. Treatment and post treatment care advice will be guided by the stages and will have to be appropriate to that phase of repair.

The healing process can be categorised in three stages. There are many different factors that affect healing time such as severity, age, nutrition, medication, early professional intervention, activity and protection.

Inflammation Phase, Acute Stage

Once an injury has been sustained, the damaged blood cells bleed, the site of the injured tissue will consist of dead cells and extravasated blood. A natural inflammatory reaction occurs involving a blood vessel and cellular response with exuded fluid resulting in bruising and cellular activity. The inflammation is triggered by blood vessels opening up and becoming more permeable (the ability to allow liquids to pass through it), this is initiated by chemical responses.

Typically, acute inflammation presents itself as swelling, bruising, increased temperature, pain and loss in function at the injury site.

Sub-Acute Phase

Repair material is generated at this stage and scar tissue is produced. This starts from 2-3 days after the initial incident and reaches its peak at 2-3 weeks. The formation of collagen (the main structural protein of connective tissue) and new local blood vessels occur to aid blood flow to damaged blood vessels from the incident.

It is common practice to immobilise the joint to prevent further damage and the patient to experience pain however some research suggests that mobilisation should be ‘optimal’ rather than restricted. The benefits to immobilising include decreased healing time, increased growth of blood vessels and stronger connective tissue, whilst the benefits of optimal mobilisation include preventing joint stiffness and reduced ROM as a result of scar tissue. It is important to get the timing right for immobilisation of the joint. If you remove the immobilisation too early the redevelopment of new tissue and blood vessels can be immature and fragile. However, if you leave the immobilisation for a prolonged period of time there can be muscle wastage and functional issues during late stage rehab.

Exercise loading has to be within the tissues limits, a good indicator for this is pain. If this is monitored well the process of healing can be accelerated. Exercise loading will help with basic movement and strength within the range of movement at the site of injury. This is essential prior to progressing through the rehab/treatment plan towards sports specific rehab.

Remodelling Phase – Chronic Stage

Around 2-3 weeks post injury (depending on the severity) collagen fibres mature and the remodelling of the tissue occurs. As the collagen matures it aligns with the typical stresses the injury site has to endure. There are different types of collagen, but one in particular is removed from the injury site and replaced with a type which has a greater tensile strength. This type of remodelling can happen for months and even years after the initial incident.
As previously stated, it is essential that in every stage of healing the treatment and rehab is specific and safe. As the injury progresses through the stages of healing, the treatment & rehabilitation has to progress accordingly. If return to sport is the goal it is essential that stages of healing & rehab are progressed through carefully and adhered to with sports specific exercises & rehab to prevent re-occurrence of the injury.

Factors that can affect the repair of soft tissue

The time in which it takes for soft tissue to repair differs from individual to individual and is dependent on many factors. The timescales in which most things are governed are a guide and an average. It is influenced by severity and the location of the injury will determine healing and repair times.

As the body ages the healing process gets slower. Connective tissue tends to have increased amounts of collagen, making them less inelastic and less pliable, so they can't move as efficiently as they once did. A greater scale of pain is felt and in general metabolisms slows down. Through training we can limit the effects of aging for a period.

Nutrition also plays a large role. Poor nutrition can deprive the body of the building blocks (amino acids) for repair. Low levels of protein will limit the capability of repair, therefore increasing recovery time and also the quality of new tissue.

Advice and the type of treatment will affect recovery time and its quality. Taking part in a suitable and appropriate programme will help with optimum recovery, however the wrong treatment and advice can have the reverse effect and be detrimental.

Rest and activity levels should be balanced. Too much rest can have a negative effect causing muscle tightness due to insufficient tensile stress. Less blood flow will also occur limiting the level of nutrient delivery for repair. Too much activity can increase the risk of re-injury to the area or causing further damage.

Unit 4: Professional Practice in Sports Massage

Aim

The aim of this unit is to provide learners with the knowledge and understanding of professional practice in sports massage

Outcomes

Explain the legislation required in sports massage practice
Comprehend the meaning of scope of practice
Explain contraindications to sports massage and the actions to take
Understand when to refer a patient to other health professionals
Know the standards relevant to the sports massage profession and possible consequences
Describe the principles of professional practice in sports massage
Explain how to produce, maintain and store client records in accordance with current legislation

Section 1: Current Legislation and Obligations within Sports Massage Therapy

The Health and Safety at Work Act 1974

The Health and Safety at Work etc Act 1974 is the primary piece of legislation covering occupational health and safety in Great Britain. It is sometimes referred to as HSWA, the HSW Act, the 1974 Act or HASAWA and provides a comprehensive framework to help promote and encourage high standards of health and safety within the workplace.
It sets out the general duties which:

- employers have towards employees and members of the public
- employees have to themselves and to each other
- certain self-employed have towards themselves and others

Within a clinic or areas of work the HSE (Health and Safety Executive) requires all businesses to display openly, the health and safety law poster.

Manual Handling Operations Regulations 1992 (amended 2002).

As stated on the HSE website, manual handling is defined as "...any transporting or supporting of a load (including the lifting, putting down, pushing, pulling, carrying or moving thereof) by hand or bodily force".

A person, object or animal can be a load. Simply picking up your puppy for example.

The MHOR 1992 set out a clear ranking of measures for dealing with risks from manual handling, these are:
first: avoid hazardous manual handling operations so far as is reasonably practicable;
second: assess any hazardous manual handling operations that cannot be avoided; and
third: reduce the risk of injury so far as is reasonably practicable.

As a sports massage therapist daily loads are placed upon the body, so a therapist's posture is vitally important. Clients' limbs and towels can all be classed as loads and moving clients into stretches will also place demands upon the therapist physically.

General Data Protection Regulation

GDPR was introduced in 2016 and became enforceable by law in May 2018. Put in simple terms it is defined as "The **General Data Protection Regulation** (GDPR) is a legal framework that sets guidelines for the collection and processing of personal information from individuals who live in the European Union (EU)"

Sports Massage Therapists process personal data, therefore are required by law to ensure it is kept safely and in a secure manor. As well as ensuring clients are aware of how and why this data is stored.

The Health and Safety (First Aid) Regulations, 1981

This piece of legislation/regulation require all employers to ensure that appropriate first aid treatments are available within the work place. In 2013 the regulation was strengthened to give clear guidance when selecting first aid training providers. This is common practice that legalisation around the regulation is continuously updated to keep with industry practices.

A Sports Massage Therapist must satisfy the following as a minimum:

- A stocked first aid kit, suitably in-line with your provision
- Appointed individual to take charge and control of first aid arrangements
- Ensuring information is available and visible in regards to first aid arrangements.

In the context of a sports massage therapist working individually or within a clinic, a risk assessment would most likely be carried out to identify at least one trained first aider on site at all times. Also highlighting whilst working at events for example the therapist must be first aid qualified.

Note: First Aid provision must be available at all times within a sports massage environment.

Working with Children and Vulnerable Adults

It is highly likely that Sports Massage Therapists will be required to work with children or vulnerable adults. It is absolutely essential that the therapist is aware of reporting policies and procedures of any suspected abuse. Its advised that online training and CPD within this area is completed. Larger organisations will appoint a safeguarding officer, however independent Sports Massage Therapists will have sole responsibility.

It is vital that the following is considered in all settings.

- Know how to recognise and report any concerns you might have.
- Adhere and follow appropriate codes of conduct and behaviour at all times. Such as:
    - Children or any vulnerable adults must have an appropriate adult in attendance at any treatment.

    - Never be alone with a child under 16 years of age or a vulnerable adult. Insist on appropriate adult being in attendance.
- Informed consent must be given in verbal form and written, by both the appropriate adult and child/vulnerable adult.

Informed Consent

It is a legal requirement to gain informed consent before any treatment or physical assessment. Any informed consent must fit the following criteria to be valid and lawful:

Informed: the client must have all the information about the physical assessment or treatment, including negative factors and not just positive that the treatment may cause.
Voluntary: It is essential that the physical assessment or treatment is the client's choice and not influenced by a Sports Massage Therapist, friend, family or team mates.

The client must be able and have the mental ability to understand what is being said. To ensure there is no confusion, clear and direct language should be used avoiding any acronyms and jargon. Clients should be given time for questions and feedback should be a two-way process. It not only removes confusion but also develops a good working relationship based on trust, which is the target for every Sports Massage Therapist.

Note: Informed consent should be recorded and discussed, once signed nothing should be added to the planned physical assessment or treatment. Blank boxes should also be scored through.

Consequences of non-compliance with legislation and professional standards.

Any non-compliance with any legal requirements such as Health and Safety, GDPR, Informed Consent or First Aid Regulations) can lead to the Therapist or the organisation being presented with prosecution or financial penalties, not to mention damage to reputation. t could also lead to being removed as a registered therapist and put limitations on any future career and future career progression and development.

Section 2: Scope of Practice in Sports Massage

Contraindications and Possible Cautions

When initially meeting and discussing treatment needs it should be considered whether treatment is viable for the client. Any contraindications or possible cautions should be identified in both the subjective and objective phase of client consultation. If there are any concerns regarding the clients physical or mental health, then a referral to another health professional might be necessary.

Contraindications

Contraindications are medical and health conditions that can be aggravated or worsened with any assessment or treatment carried out by a Sports Massage Therapist. They can be divided into two types, that must be understood to make a valid and fair assessment before any treatment/assessment is carried out. They are:

- Local: - A condition located in a specific area that should be avoided, however treatment around it may be beneficial. An example: An acute muscular injury. Muscles around this area could help assist blood flow and the repair phase.
- Total: - Any type of massage is not recommended. These conditions most likely are highly contraindicated to both client and therapist.

Cautions

This is a health or medical condition that will require a therapist to adapt a treatment to ensure safety or effectiveness. This includes clients positioning, therapist positioning, lotions, lubricants or even choice of massage stroke e.g. a pregnant client will require a change of positioning.

Note: If a client states that their conditions have deterioration during before or after a massage, the therapist must recommend that that client seeks to consult their GP or another medical professional such as a physiotherapist, before any further treatment or assessment. Therapists also have the right to defer or refer a client if they have any concerns about a sign, symptom or condition reported.

Referral

It is important to understand the limitations in a particular field of study or personal expertise. A good therapist will understand the need to refer a client, when the client needs exceed their professional limits. There are multiple reasons that a therapist may refer to a GP or other health care professional when presented with issues beyond their competency. At other times where advice or guidance from a suitably qualified professional might also be appropriate. The list can include:

Physiotherapists	Physical therapist	Occupational Therapists
Osteopaths	Sports Massage Therapists	Chiropractors
Personal Trainer	Counsellors	Medical Specialists
Sports Coaches	Podiatrists	

Section 3: Professional Standards of a Sports Massage Therapist

All professional associations generally adopt key principles and standards, such as the following:

- Hold current and valid insurance, including professional indemnity insurance
- Hold a valid and recognised First Aid certification
- Follow and adhere to professional regulations in regards to personal presentation and hygiene
- Ensure complete confidentiality and follow GDPR guidelines
- Ensure and maintain appropriate communication with clients
- Provide highest standard of treatment within your professional boundaries
- Demonstrate high levels of professionalism, integrity, reliability and honesty.
- Abide by Health and Safety Act, ensuring measures are taken to protect the health and safety of every client
- Ensure informed consent is gained for ALL treatments and assessments
- Continue with CPD (varied amount within each association.).

The Role of Professional Organisations within Sports Massage and the Importance of Regulation

Within the sports massage industry professional memberships and organisations aid SMTs to maintain standards. The provide the framework and codes of conduct that help to ensure:

- Improved standard's, ensuring development and consistent improvements in the industry.
- The highest level of care for client(s)
- Support for the Sports massage therapist to aid them upholding appropriate and high standards.
- Up to date register of qualified SMTs.
- Confidence within the profession from other medical professionals and health care professionals.

The Value and Importance of CPD for a Sports Massage Therapist

CPD is defined as any learning undertaken within a professional boundary. Any research, reading, development courses that help improve a therapist's skill set or knowledge or both. Benefits of CPD are:

- Keeping up to date on new and emerging techniques.
- Keeping up to date of new research into existing and new massage techniques and practices.
- Differing viewpoints being researched

Within each awarding body, council or organisation the amount of recommended and advised CPD varies. It can also come in many different formats, such as reading publications, magazines or published papers, development training days, new levels of qualifications (within chosen field), working with professional bodies and teams or researching industry websites. It is important to check each for their validity within each organisation.

Emergency Action Plans

Preventing emergencies is a priority for Sports Massage Therapists and organisations. In clinics or any organisation risk assessments, policies and procedures in regards to health and safety as well as operating should be in place to help minimise risk and emergencies from happening.

Risk assessments are completed which are accompanied by an Emergency Action Plan which is a procedure that must be followed in the event of an emergency to ensure maximum safety of all. These include things such as a fire, chemical spillage, theft, accident causing injury any kind of sudden illness.

Within the EAP a Sports Massage Therapist may be required or tasked with things such as helping with evacuations, log and record incidents, calling the emergency services, administering first aid.

Outside of an organisation or a clinic base setting (such as an event), it will be the responsibility of the therapist to familiarise themselves with any procedures in place such as the EAP for the event.

Producing Risk Assessments

If there are no EAPs or risk assessments in place the Sports Massage Therapist will need to carry out their own.

FIVE STEPS TO RISK ASSESMENT	EXAMPLE
Identify any potential hazards	Pre-Event at a remote rugby pitch. Hazards can include litter on the field, impact against other players, poor tackles, slips, trips and falls, any general medical emergencies.
Decide who might be harmed and how	Players, referee, officials, spectators. Any type of injury or medical emergency such as a fit.
Evaluate the risks and decide on the precautions	There is a fairly high risk that someone could be hurt or injured and need medical attention. Precautions could include things such as holding a first aid certificate in date, mobile phone for calling emergency services, fully stocked first aid kit, de-fib and trained staff/therapist.
Record the findings and implement them	Have a risk assessment or emergency plan written. Make sure everyone understands it and the procedures and measures required.

Review the assessment and update (as required)	If any situation changes. As weather becomes extremely hot. Be ready to review and make changes if required.

Managing accidents and sudden illness.

The effects of an accident or a sudden illness can cause major stress upon the human body. It is vital that the therapist remains calm. Many situations can be very traumatic on both therapist and clients if situations arise. In some cases counselling may be required.

C.A.L.M is an acronym that outlines the steps to follow in such situations:

- C Calm yourself and remain present
- A Assess the situation, what happened and how did it happen?
- L Locate some assistance if it is available such as first aiders and emergency services.
- M Make the area safe. Remove bystanders and anything that may cause further harm, if possible.

Insurance Requirements for a Sports Massage Therapist

Insurance can be a very difficult subject with differing levels offered and multiple companies to go through. It is essential that every Sports Massage Therapist takes out professional liability insurance as it is a legal requirement. It is the therapist's responsibility to ensure they have the specific insurance for what they are doing.

Any professional who operates a business requires professional liability insurance for them to practice and operate.

Public liability is quite often a condition of many organisations and professional memberships. Sports Massage Therapists are legally required to cover any damages or associated costs should they be found liable for any event that injures a client whilst under the care of the therapist or in their practice and premises.

Other types of insurance to be considered include:

Home/Clinic contents – Any clinic equipment can be covered by home or building contents insurance, there will also need to be cover in place for equipment away from the home as it is very common to work in unsecure places.

Travel Insurance – If a therapist is working abroad or different location to usual consideration should be given to travel insurance and must include equipment and possessions.

Home and motor insurance – If using a private car for business then normal cover must be upgraded to cover business use.

Personal accident, income protection and critical illness cover – It is highly recommended to have this type of cover as most therapists will be self-employed.

Section 4: Professional Practice in Sports Massage Therapy

As with most services, being professional is of the utmost importance and it is essential for any practicing Sports Massage Therapist to be successful. To ensure longevity within the industry, it is important that clients respect and trust their therapist. By being professional a therapist will be able to build a strong rapport with their clients and gain their trust.

This is also true with other professionals that refer clients to Sports Massage Therapists as it is an extension of both yours and their services.

Equality and Diversity

Sports Massage Therapists should demonstrate and promote respect for every client. A high standard of ethics and professional standards will gain the confidence of clients. All clients should be treated with the same care and dignity regardless of gender, ethnicity, physical and mental ability, religion, status and sexual orientation.

Personal and Clinical Standards

Clinical and personal standards should be held in the highest regard and standard to enable a Sports Massage Therapist to uphold a professional reputation with clients and other professionals. Being presentable with a clean uniform, clean equipment and clinic area and personal hygiene will aid a positive perception of the therapist and their services. Upholding all professional standards and policies are vital.

Communicating with your clients professionally.

Communication and the creation of a safe environment will promote repeat business and trust. Many things can affect an environment for a Sports Massage Therapist to work in. Maslow (1974) outlined that for an effective environment to be created an individual's basic needs must be satisfied. Esteem, healthy relationships (being listened to and empathy for example) and safety are vital to foster a healthy relationship and trust.

A therapist needs to listen and respond effectively. The correct use of questioning is an important skill in allowing the client to tell their story. Using open questions with phrases such as 'who, when, why?'
Once a client has had a chance to discuss and outline the story more specific questioning can be used to help to narrow down the information.

It is important to listen attentively, ensuring the client feels valued. Positive body language, such as open arms, nodding head and appropriate eye contact should be adopted as any signs of disinterest and lack of interest will give a negative feel and affect a working relationship, lessening the trust.

Active listening shows the client they are being listened to and that the therapist understands how valuable their input is. Repeating key information reflects that they are being listened to and can be used to question a statement or clarify what has been said.

When giving advice it should be clear and concise and delivered at a level that is understandable to all. It is important to confirm that they understand the type of information given to them.

Forms of Communication

There are many forms of communication to use with clients and other professionals. The type of communication and what will be most effective is dependent on individuals and their likes and dislikes, as well as access. Different methods may also be more suitable for different occasions.

Social media can be a very good tool to maintain communication and awareness with a client base. It could be used to promote to future clients, highlighting new clinic improvements and equipment for example.

METHOD USED	ADAVNTAGES	DISADVANTAGES
Instant messages. Such as WhatsApp / Facebook messenger / Instagram	Very easy to use Free to use Very quick Provides a record of receipt and if message has been read.	Might not as user friendly to older generation Too informal Dependant on internet connection / 3/4g
Email	Very quick Can be formal and informal Provides a record of receipt sending Can be managed on mobile devices and tablets	Can be difficult to convey tone Can be perceived as 'too easy' Can be often deleted in error or end up in spam folders due to firewalls.
Text	Easy and quick to use Useful to remind individuals of up-coming appointments Can be auto sent with many applications Can be sent in groups, saving time	Can be seen as too informal and over familiar Information can be easily misunderstood and difficult to get across manor and tone
Telephone	Can be formal or informal in nature Adds a personal touch in today's society Can get first-hand information and confirmation Can pitch across tone and manor more effectively Lots of information can be passed quickly and effectively	Can cost No record of any discussion or agreements An be difficult for formal conversations Language barriers can occur
Face to Face	Best form to build a client rapport Can use verbal, non- verbal communication to promote a warm environment. Can be formal or informal	Can be confrontational with constructive feedback Some less confident and skilled can come across with the wrong tone.

Unit References:

The SMA Code of Ethics and Conduct – www.thesma.org

Institute of Sport and Remedial Massage – www.theisrm.com/terms.php

Complementary and Natural Healthcare Council (CNHC) – www.cnhc.org.uk

Federation of Holistic Therapists (FHT) – www.fht.org.uk

The council for soft tissue therapies – www.gcmt.org.uk

The National Institute for Health and Care Excellence (NICE) – www.nice.org.uk

The American College of Sport Medicine (ACSM) – www.acsm.org

The Department of Health – www.gov.uk/government/organisations/department-of-health

The British Association of Sport and Exercise Science – www.bases.org.uk

Unit 5: Sports Massage Therapy Treatments

Aim

The aim of this unit is to provide learners with the knowledge and understanding of the fundamentals of sports massage treatments and be able to apply, carry out and evaluate sports massage treatments.

Outcomes

Explain how sports massage can complement other therapies and treatments
Comprehend the environment and resources required for sports massage treatments
Explain how to assess and screen clients for sports massage treatments
Carry out subjective and objective assessments
Devise sports massage treatment plans
Apply sports massage treatments safely and effectively
Evaluate sports massage treatments

Section 1: History of Sports Massage Therapy

Massage is defined by the Oxford Dictionary as "the rubbing and kneading of muscles and joints of the body with the hands, especially to relieve tension and pain".
As a Sports Massage Therapist the aim is to relieve pain and discomfort, returning the client to as close to full function as possible.

Massage and its origins date back centuries and the practice is far older than the terminology. Hippocrates used massage as early as the fourth century BC, with evidence and references of massage having been found across the world and within many differing cultures.

When the term 'massage' was introduced, the definition of practice was generally accepted, remaining unchanged to what we know in the present day. John Harvey Kellogg (1895) published a book named 'The art of massage', within which are individual terms used to define strokes, most of which are still used today. These terms were:

- Petrissage – Kneading at a deep level
- Effleurage – Stroking and light friction
- Tapotement – Percussion

Throughout the ages massage was generally practiced by those recognised within a medical profession, however from the 1980's, massage began to be recognised as a separate entity and profession. After this time, research has been conducted to outline its therapeutic and clinical effects, resulting in a number of different types of massage to emerge. These include:

- Swedish
- Thai
- Hot Stone
- Sports Massage

The Development of Sports Massage

In the late eighteenth and beginning of the nineteenth centuries, Swedish massage was developed by Per Henrik Ling to help fencers and gymnasts prepare and recover from competitions and modern sports massage as it is currently known was born.

Sports massage can be traced back to its origins through its use by support crews during cycling tour races, where the recovery of a cyclist is essential. It has become increasingly used for a whole range of activities and not just limited to sport. Anything that calls for recovery and work of specific muscular concerns could now be treated by sports massage if required.

Many techniques are the product of need, as well as diversity in order to help meet specific demands of the sport. It has also led to differing approaches and techniques within specific timeframes, for example types of sports massage used in pre and post event differ in their application, as they have different targets and aims.

By the 1990s, both sports massage and sports therapy were recognised as professions, with specific training available and professional associations and standards forming to ensure the safe practice of the profession.

In the current day, the standardisation of the profession has been brought into focus with additional techniques, qualifications and competencies.

Sports Massage Therapy to Complement Other Therapies and Treatments.

Sports massage professionals must be aware of and understand how the profession can complement other professions in regard to treatment and general well-being such as:

- Physiotherapy
- Personal training
- Physical Therapy
- Counselling
- Podiatry
- Osteopathy
- Chiropractor

As well as professions, types of treatment could be:

- Acute Injuries
- Chronic Injuries
- Maintenance and development of training programs

Sports Massage Therapists may be required to provide general massage to a patient once they have completed their medical/curative treatment. Many medical professionals (such as physiotherapists) will only provide treatment to a point, where the specific injury/trauma has recovered, and commonly will not look at a client holistically to identify or see potential causes of the injury. Possible dysfunction within another area might cause compensatory patterns increasing stress, therefore an injury occurs at the area of most stress and vulnerability.

A Sports Massage Therapist can continue assessing potential areas of dysfunction, helping to provide a holistic approach to reduce the risk of injury re-occurrence, breaking down adhesions and improving flexibility within the process.

A good sports massage therapist will be able to provide a treatment package for specific individuals that compliments the treatments/training they already receive. A good example of this working relationship would be providing an athlete with pre and post treatments to help them prepare and recover whilst working with their strength and conditioning coach to complement their training and helping to enhance performance.

Section 2: Fundamentals of Sports Massage Therapy

Sports Massage environments

Sports massage is utilised in a variety of settings within modern society, both clinical and non-clinical in nature. Therapists could be working in a clinic one week and by a sports field the next, in changing rooms, dug-outs or by a race track. Regardless of location and situation, every Sports Massage Therapist should hold the highest possible standards of practice and hygiene. With recent COVID-19 outbreaks this has never been more closely monitored.

Clinical Environments

- A hand basin or sink should be available, enabling the therapist to wash their hands between clients regularly
- Ant-bacterial gel
- Toilet facilities
- A warm, temperature regulated room
- Bin, regularly emptied and lined
- A plentiful supply of clean laundered towels, linen and couch roll should it be needed
- Clean and tidy space

Outside and Event Based Environments

- An area clear of hazards and obstacles and not large groups of passing human traffic where possible! (In most events areas will be sectioned off)
- Alcohol wipes and anti-bacterial gel to ensure hands are kept clean
- Couch roll
- Sufficient room for the therapist to move around
- Floor support - such as 4 squares of wood for massage table legs to stand on to prevent sinking into wet ground
- Stable and flat ground where possible
- Maintain as much privacy as possible
- Avoid working under trees due to risk of falling branches and bugs/insects
- Cleaning spray and cloths to wipe down equipment after treatment

Equipment used within Sports Massage Therapy

Types of couch are wide and varied, with many different types advertised from many different suppliers. The key to selecting the correct couch is to match it to the needs of the business. For example, if doing event work something light and durable is needed, whereas within a clinic it can be heavy and aim to provide a more luxurious feel. As a general rule, couches should have an adjustable height which is vital to help maintain your posture throughout your treatments.

Other considerations such as material type (wood squeaks more once exposed to the elements), weight, cost, 3 section or 2 section, type of client, storage bag, moving the couch (how often) will also dictate the couch that should be used.

There may also be instances where massage takes place without a couch. Massaging the gastrocnemius for example whilst during a team talk the player could be seated. It is important for the therapist to maintain their own health and safety, such as posture and props can be used to stop hyperextension. Useful surfaces could include:

- Chairs
- Changing room benches
- Car Seats
- Step Boxes
- Mats

Couch Set Up

Ensuring the couch is at an appropriate height for the therapist is vital in protecting their own health and safety, as well as ensuring the best possible service and massage delivery to the client. The basic rule for judging the height of the massage couch is to stand next to it with a clenched fist by the hip. If the fist touches the table from the hip, generally that is an appropriate height. However, each individual is different and the circumstances may require this to be altered, for example if treatment was delivered to a rugby team, the players could be quite large, especially when lying on the couch, so the table may need to be set lower than normal.

Effectively using Towels, Pillows or Bolsters

These 'props' can be used to help improve client comfort and aid in relaxation of the muscles. Props can be fashioned from many different things; a folded hand towel, a rolled-up shirt or sock, a water bottle etc.

A range of different props can be bought from specialist suppliers. Bolsters for example come in a variety of shapes, colours, sizes to suit all types of circumstances and clients.

Towel Positioning and Client Comfort

Providing privacy and comfort to a client is of upmost importance. Making clients feel safe, both psychologically and physically is a hugely important part of being a Sports Massage Therapist and should not be overlooked. Effective draping helps the client feel appropriately protected and safe, building an element of trust.

It is important to consider differing scenarios also that may arise, especially on events and on-site treatments.

Pillows and bolsters should be utilised for client comfort e.g a towel to support the knee joint whilst working supine and a bolster to support the ankle whilst working prone.

If the couch has no face hole, then a towel can be placed to support the forehead when in a prone position and a towel under the abdominal region will help prevent excessive lordosis.

Whilst lying supine it is important to support the head to ensure the client maintains a neutral cervical spine position, as well as supporting the knee and ankle. Whilst working on the iliotibial band, place support under the client's knee with the hip flexed.

AREA:	DESCRIPTION:
Draping the legs	Take the bottom corner of the drape and use a long diagonal fold from the hip, tucking firmly above the same side knee. Avoid tucking underneath the opposite leg as this creates a bit of a wind tunnel – not so comfortable for the client.
Side-lying draping, T-draping:	Have one towel lengthways along the whole length of the body; then place another horizontally on the torso. To turn the client into a side-lying position from prone, hold both towels down on your side and get the client to turn towards you. With the client's bottom leg straight and top leg bent, bolster under the client's head and their top knee to ensure hips and spine are in line. You can also position the client with both knees bent and a bolster between them for comfort. Rest client's upper arm on top of the drape then fold the top towel over this arm to reveal the back.
Breast draping	Have one long towel placed from chest to toes on your client. To expose the abdomen, use another large towel folded in half or thirds lengthways. Lay this towel in a T shape so that it covers the breasts. Hold the top towel with one hand then pull the bottom towel out from underneath to expose the belly. Fold the top towel over.
Supine draping	To turn the client supine from a side-lying position, stand in front of client, hold the towel and ask them to turn away from you onto their back.

Oils, Lotion and Wax

The best medium is whatever is best for the client, situation and therapist. Using the correct medium can ensure that the skin doesn't become hot, twisted and painful. There are a number of different mediums available that all lubricate the skin and reduce friction.

Oils

Oil is the most common and most referred to of all mediums. There are various types such as vegetable, nut, seed and olive oils. They can be nutritional for the skin and can be bought cheaply. An area most viable for such mediums is event work due to its vast nature and high turn-over. Oils could prove most cost effective, however allergic reactions must be taken into consideration.

Wax

Massage wax is the least commonly used and most expensive. They can be tailor made and bring a sense of luxury to treatments.

Lotions

Lotions are quickly absorbed by the skin, especially if a client is dehydrated and has a lot of hair. That means it is more expensive to a Sports Massage Therapist due to the fact that more will need to be used. It does provide excellent lubrication and limited glide, so it is very good for deep tissue massage but is perhaps more suited to a clinic setting.

Creams

Creams are thick and have a less greasy feel. They are perhaps most suited for foot and facial massage, although as a Sports Massage Therapist its use in this sense will be limited.

Powders

Powders are not often the first choice for any Sports Massage Therapist due to it having less lubrication qualities to reduce frictions. It is good at lessening residue upon the skin, however the particles could irritate a client's nose and throat.

Maintaining Posture

Maintaining good posture during treatments should not be underestimated. The importance of maintaining a healthy posture is vital for any Sports Massage Therapist to prolong their career. Therapists are put under lots of physical stress so before every treatment the following should be considered:

- Maintain core stability throughout any treatment to minimise pressure on the lower back
- Utilise body weight and lean into strokes. Transfer body weight, lean in and use the feet to lift and rock onto the soft tissue
- Adjust the height of the couch to maintain spine alignment

Types of Sports Massage

Pre-Event sports massage

Before any event pre-event massage can be utilised. Pre-event massage is undertaken before a workout, competition or sporting performance with the aim to increase blood circulation, flexibility and mentally prepare people for activity and enhance performance. Pre-event massage is a short and specific massage treatment, application is fast and deigned to increase soft tissue temperature and pliability, ready for activity.

The muscles targeted are those mainly used within the event/game/race and the main techniques utilised are effleurage and petrissage. Quick and vigorous, the massage should last between 5-15 minutes with a high level of speed to stimulate and warm the muscles involved.

Post-Event Sports Massage

The aim of a post event massage is to prevent injury and promote repair. The massage should ideally take place immediately after the event/game, however if the treatment is post 24-48 hours then the massage can be classed and treated as one of maintenance. A post event massage will help both physiological psychological recovery, removing waste products that cause aches and pain such as lactic acid as well as relieving stress within the muscles ensuring the client feels better and relaxed.

It is best carried out in a more relaxing environment, although this isn't always possible within amateur/semi-professional sport. Treatment tends to last 20 minutes to an hour and strokes are lengthened and deeper whilst utilising passive stretching.

Inter and Intra Sports Massage

Inter-event sports massage is between events - hours or days apart.
Intra-event sports massage is during the event itself, perhaps at half time.

Due to short time scales and access to treatment, recovery and effects will be limited. Needs must be discussed with the athlete/player, but if the techniques are applied too slowly it could make an individual too relaxed and not ready for competition. In general, if the techniques are applied similar to that of pre-event this will minimise any negative effects.

Maintenance Massage

Maintenance massage is the most common delivered by Sports Massage Therapists. They are most likely to occur in a clinical environment with clients wanting to target any form of dysfunction and pain.

One of the most vital and important areas of this type of treatment is the consultation, allowing an effective Sports Massage Therapist to gain specific information to tailor the treatment specifically to the client.

Sports Massage Therapy Techniques

A variety of techniques can be utilised with clients dependent on their needs.

Effleurage

Effleurage meas to 'flow and glide' and is the foundation of any massage treatment. Effleurage is a form of massage involving a circular stroking movement made with the palm of the hand. The term effleurage derives from the French word 'effleurer', meaning to 'skim'.

The technique is used throughout massage and dependant on depth and speed serve many different purposes. The technique can include light stroking, firm stroking and deep stroking.

Performed in a smooth, rhythmical and relaxed manner, starting with a light touch at the start of a session and building up to deeper pressure with slower movements for increased circulation and stretching of the tissues later. The hands must be relaxed and follow the natural contours of the client's body.

The palm engages with pressure being applied towards the heart and reduced on return strokes. Make sure you avoid placing any pressure on joints. The depth of application (pressure) can be gradually increased as client and tissues relax or as the circumstances allow. In Pre-Event work it will be lighter and quicker in speed.

Petrissage

Petrissage is defined as 'to knead'. The term petrissage is derived from the French word petrir. Petrissage is generally used to have a deeper effect on soft tissue than effleurage, and includes kneading, squeezing, picking up, shaking (and other techniques described as wringing and rolling, which achieve much the same results).

The hands will work alternatively to lift the muscle, taking a firm grasp of the soft tissue.
To help reduce the risk of pinching, grasp the tissues with either palm of hands or pads of fingers. Dependant on muscle size the technique may vary. Also within circumstance the pressure and speed may alter.

Vibrations, Shaking and Cupping

These techniques aim to promote blood flow and the activation of the muscle tissue and are used with effleurage and petrissage. They add variety into the treatment, helping to initiate the pain gate theory.

Vibrations and shaking of muscle tissues are aimed to stimulate the client's nervous system as well as helping to prepare the muscles for deeper work - to promote blood flow and increase temperature.

Vibrations are applied by pressing lightly onto the targeted soft tissue and then using your hand or fingers back and forth quickly, vibrating. Whereas shaking involves picking up the muscle and shaking it rhythmically.

Tapotement

Tapotement is the term used for describing some techniques such as hacking and cupping which are aimed at stimulating and improving circulation, acting upon the sympathetic nervous system and covering several differing techniques.

Hacking is a technique in which both hands alternately strike the skin with the lateral borders of the fifth finger of each hand. As the other fingers close together on striking the skin, a characteristic sound is made. It is known to stimulate the skin and superficial muscle tissue, preparing the muscle for exercise and hence being an option for pre-competition massage.

Cupping involves making an air-tight concave shape with the hand so that, as it strikes the surface, the air caught underneath is compressed, creating a vibration that penetrates the tissues. Characteristically, it also creates a vacuum as the hands are pulled away, and therefore by stimulating the superficial tissue can move blood away from deep tissue, a fact which may be considered counterproductive for sports massage.

Pounding involves loose fist shapes rotating over each other. Beating is applied with your hands in loose fists alternatively dropping onto the tissues, striking with the heel of the hand.
Other techniques achieve most of the same effects, together with additional benefits, more efficiently so tapotement is not widely used.

Stand facing the client and the area to treat. With alternate hands 'strike' the client's tissue in a rhythmical fashion at speed, keeping your joints and hands loose to avoid any discomfort.

Kneading frictions

Frictions are small forceful movements applied back and forth over isolated areas using the pads of the fingers or thumbs – utilising considerable pressure compared to the techniques described so far. They are applied adjacent to the direction of fibres and hence, are often referred to as 'cross-fibre' frictions. It is vital to understand that such techniques actually disrupt the tissues in order to realign new fibres and therefore must be used sparingly and only when the need arises – see below. Several benefits of frictions may be generated by using deep stroking instead; the subtle difference between the two techniques being slightly less pressure and therefore no disruption caused.

Using the fingertips, thumbs or palms/fist. Place the muscle you are targeting in a relaxed and shortened state. You then apply pressure to where you feel (palpate) tension or adhesions. It should not be painful but enough stress to the underlying muscle tissue. Moving up and down back and forth in short movements, along the muscle line. To promote the stretching of the tissue. If the skin slips look to remove lubricant.

Stretching

Stretching can be a vital technique if done correctly. Helping to promote flexibility and range of motion (ROM), the application of passive stretching within a sports massage treatment aids the lengthening of the fascia as well as increasing circulation to and through it. The release of the fascia's tight grip on muscular, neural and vascular structures creates an increase in the client's range of motion as well as a decrease in discomfort or pain.

Passive stretching is when you use an external force, such as a wall or band, and use it to facilitate the desired stretch. Helping both agonist and antagonist to relax. Often used in injury re-hab.

Active stretching can also be described as static-active stretching. You take a position and then hold it, with no assistance other than using the strength of your agonist muscles.

Maintenance – Taking the targeted muscle to the point of mild tension and then holding for 15-20 seconds.

Developmental – This type can be used to improve ROM in targeted muscles by the sports massage therapist. Upon the feeling of an ease in tension, the stretch is then taken further to help increase ROM of the targeted muscle. This process can be repeated. Moving a little further each time when the muscle relaxes. How-ever note if the muscle begins to shake then immediately lower the stretch to its previous position.

Section 3: Client Analysis and Treatment Planning for Sports Massage Treatments

Clients tend to seek sports massage treatments for a primary reason, whether it be a mild aching muscle, high levels of discomfort or help with injury. The goal as a therapist will always remain the same "relieve symptoms and promote a health condition."

As with any kind of treatment or care, an initial plan must be formulated, and the client's current condition assessed. This will allow a successful analysis the client so that suitable treatments can be devised for that individual. A one size fits all approach should not be used and treatments should be specific, even if the treatment is simple the results will be better and therefore referrals more frequent.

Assessment will be based on two main methods:

- Subjective Assessment
- Objective Assessment

A subjective assessment is not measurable and can be argued. It tends to be verbal, where a therapist is told about clients symptoms and feelings.

An objective assessment is clearly measurable and can be quantified with evidence with what is being seen/observed and tested.

As with most initial contacts and meetings it is important to give a good first impression. A client consultation is essential to gather vital information to ensure a specific treatment and future plan. It will also give an insight into the client's lifestyle and post treatment advice and care can be based upon this as well as the condition. A client analysis gives a Sports Massage Therapist the opportunity to gather important information such as:

- Use information obtained both subjectively and objectively to have informed treatment plans (specific)
- Refer your client if the information presents itself
- Gain consent for any treatment and physical assessment
- Complete treatment paperwork completely and record a treatment plan in the presence of your client.
- Ask questions, both therapist and client allowing a two-way process.
- Be involved
- Build a rapport
- Gain primary reason for their visit.

SOAP

Regardless of the reason for the client's visit, the Sports Massage Therapist should always carry out both subjective questioning and some form of objective assessment prior to treatment. This will best enable them to develop a treatment strategy which fully suits the client's needs.

S	Subjective - information gathered from the client in response to questioning
O	Objective - information gathered from a physical examination
A	Assessment - interpretation of the information gathered during the subjective and objective phases and proposed treatment(action)
P	Plan - written record of any of the treatment and / or post-care advice given

With non-pathological tissue, it is generally considered sufficient to:

- subjectively determine the client's expectations in regards to treatment and determine if such treatment is appropriate
- objectively assess the client's range of movement, since this gives good visual indicators to both client and practitioner, of both the current condition and if any progress or improvement has been achieved through treatment

However, with pathological tissue a more detailed approach is necessary.

Subjective Assessment

This involves a sports massage therapist gathering information from their client, that can't be measured or quantified. During this process information and opinions will be gathered from the client for their primary reason to seeking treatment, any past and present injuries or dysfunction. Information collected can be the following:

- **Personal Details** – Such as the occupation, client lifestyle, any previous medical conditions, contraindications.
- **Condition Presenting –** Their reason for the visit, any symptoms, any known causes or any factors that can relieve symptoms or aggravating them. Changes in current lifestyles, hobbies, lifestyle or training.

Recording this information is vital to ensure that the pathology of a client's injury/dysfunction is understood. Using the client record paperwork, information should be recorded, this includes any referral letters, if there is any doubt then communication with the referring professional should be obtained and sought.

Once the documents have been completed the therapist can then determine if the client can be treated.

Client Details:

TITLE: _____ DOB: _____

SURNAME: _____ GENDER: _____

FORENAME: _____ CONTACT NUMBER: _____

EMAIL: _____

Emergency Contact Details:

NAME: _____ CONTACT NUMBER: _____

RELATIONSHIP TO YOU: _____

REASON FOR YOUR VISIT TODAY: _____

_____

Clients' details are important. They must be recorded clearly and with accuracy. They allow for communication with the client as well as emergency details.

Clients Lifestyle and Work Details:

OCCUPATIONE: _____ FULL/PART TIME: : _____

DAILY ROLES AND ACTIVITIES (both physical and sedmentary): _____

_____

_____

_____

ANY CHANGES RECENTLY: _____

DO YOU EVER END YOU WORKING DAY WITH PAINS OR ACHES: _____

The clients' lifestyle offers a insight into possible causes of dysfunction/injury as well as potential for continuing pain.

Hobbies/Interests:

WHAT TYPE OF HOBBIES OR INTERESTS DO YOU PARTICPATE IN: _____

_____

_____

_____

HOW MUCH PHYSICAL ACTIIVTY/EXERCISE DO YOU PARTICPATE IN WEEKLY ON AVERAGE: _____

_____

HAS THIS CHANGED IN THE LAST YEAR: _____

_____

MEDICAL HISTORY:

GP NAME: _____ **CONTACT NUMBER:** _____

SURGERY ADDRESS: _____

_____

NOTES: _____

_____

_____

Medical history is important so a therapist can firstly decide if treatment is applicable (referral might need to happen) and secondly to foresee any issues and potential future issues.

Upon the following list, do you or have you had any within the last 6 months. Circle which ones apply to you and discuss the details with your therapist.

YES/NO (Delete as appropriate.).

Details: _____

_____

_____

_____

Have you needed to visit your GP in the last 6 months? **YES/NO**

Details: _____

_____

_____

Asking open questions will help a client 'open' up and offer insight. Explore the discussion to ensure a rounded picture and history.

Objective Assessment

The purpose of an objective assessment is to justify and measure client dysfunction and possible reasoning. If a client reports upper back pain and loss of range of movement a therapist can employ objective assessments to measure by palpating the area, postural analysis and ROM tests.

Postural Analysis

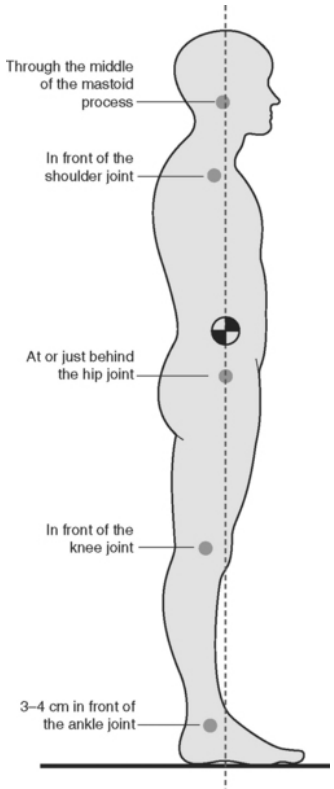
Posture can be defined as the attitude or position of the body (Thomas, 1997) and according to Martin (2002), should fulfil three functions:

1. It must maintain the alignment of the body's segments in any position: supine, prone, sitting, quadruped, and standing
2. It must anticipate change to allow engagement in voluntary, goal-directed movements such as reaching and stepping
3. It must react to unexpected perturbations or disturbances in balance

Posture is vital for balance and control of the body when motionless as well as during a wide variety of different types of human motion. To ensure long term health of the spine and joints of the body optimal postural position should be sought for at all times when holding static positions (sitting, standing) but also during movement and activity. Postural position is predominantly under our subconscious control.

The conscious mind is normally focused on a goal-oriented movement and not on the exact positioning of the joints required to ensure each specific sub-movement is effective. However, the body has numerous sensory receptors found within the muscles and joints to help provide neural feedback regarding limb and spinal position, speed of movement and the forces passing through the joints in order to subconsciously control the response required for each one of these factors.

If optimal posture and postural control is to be encouraged during exercise performance the principles of good static posture must first be fully appreciated. Once this is understood poor posture can be identified and corrective strategies adopted.



"Good posture is the state of muscular and skeletal balance that protects the supporting structures of the body against injury or progressive deformity irrespective of the attitude (e.g. erect, lying, squatting, stooping) in which these structures are working or resting" (Posture Committee of the American Academy of Orthopaedic Surgeons,1947).

"Poor posture is a faulty relationship of the various parts of the body, which produces increased strain on the supporting structures and in which there is less efficient balance of the body over its base of support" (Posture Committee of the American Academy of Orthopaedic Surgeons, 1947).

Causes of Poor Posture

There could be many different factors that may contribute towards faulty static and dynamic posture. Some of the primary reasons may include physical trauma, congenital or acquired deformity within the musculoskeletal system or some form of faulty loading pattern (FLP).

Faulty loading patterns may occur as a result of repetitive movements or consistently held static positions that are simply part of everyday life e.g. an office worker who has chronic shortening of the latissimus dorsi muscles will likely struggle to raise the arms above their head without overextending their lumbar spine. If they are given repeated overhead pressing movements in the gym lumbar spine dysfunction and pain is almost inevitably going to be the outcome as the forces will be loaded through the spinal discs in an extended position. They may also be observed in an athlete who repeats movements to meet the requirements of a specific sport or skill within the fitness arena.

Implications of Poor Posture

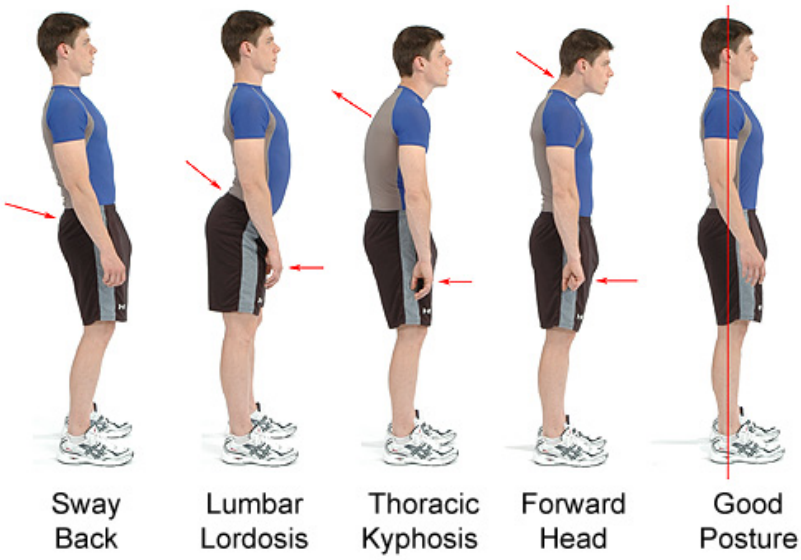
One implication is impaired movement. Sahrmann (2002) identifies the main causes of deviations in joint movement patterns as repeated movements and sustained postures associated with daily activities of work and recreation. Poor posture, whether static (a sustained posture) or dynamic (as expressed in repeated movements) will induce changes in the components of the movement system. This is particularly relevant to the fitness and sporting arena where sustained postures and repeated movement patterns are an essential part of the activities people engage in.

It has been shown that cyclists who spend 3 hours riding their bicycles in a position of lumbar flexion have a reduced lordosis in the lumbar spine when compared to a control group who did not ride bicycles (Sahrmann,2002). In this case, the maintenance of a sustained posture necessitated by the requirements of a sport has directly altered posture in the longer term. This will in turn affect movement, since such an individual is poorly prepared to maintain a neutral spine during lifting movements and is likely to migrate to their position of strength (i.e. lumbar flexion) during such movements.

Observation of the client begins when they first enter the room and should be of:

- client movement when walking, sitting down, standing up and disrobing
- client posture when sitting and standing
- the visual presentation of the musculoskeletal system
- the visual presentation of the skin

Note that the sports massage practitioner is standing far enough away to obtain a clear view of the whole body

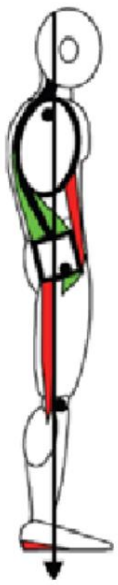


By looking at the way our client stands, walks or sits can give clues to areas of discomfort or problems. For example, a forward head could indicate a muscular imbalance within the chest region, pulling the shoulders forward due to weaker back muscles (common in young males).

Use bony landmarks and structures to compare and contrast areas such as the knee lines, creases of the bum, PSIS/ASIS position, inferior angle of scapula, shoulders, ears.

There are three more common primary postural deviations in relation to the spine when viewing the body from the side; a flat back, a hollow back and a sway back position (Kendall, 1993). These primary 3 deviations affect the body in the sagittal plane of motion but are not the only type of postural deviations that can occur.

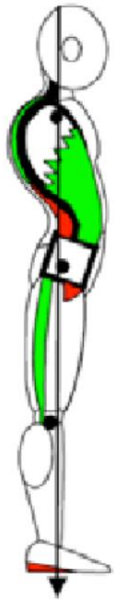
Deviations such as scoliosis, pelvic torsions, protracted shoulders, knock knees and flat feet, amongst others, all occur with reasonable regularity in the general population. However, an understanding of these 3 common spinal deviations can help inform as to what the other areas of the body may be doing in terms of likely compensations.



Flat back

To the naked eye the lumbar region of the client's spine will appear to be flatter than would be considered the ideal 'norm'. More specifically the postural characteristics of a flat back are:

- forward head carriage
- slightly extended cervical spine
- increased thoracic curvature
- flattened (flexed) lumbar spine
- posteriorly tilted pelvis
- hip joint in extension
- knee slightly flexed
- ankles slightly dorsiflexed

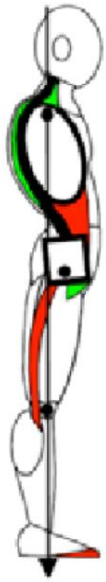


Hollow Back

A hollow back position is so called because the lumbar region of the spine may appear to have a larger curve or hollowing. The specific characteristics of a hollow back are:

- forward head carriage
- slightly extended cervical spine
- increased thoracic curvature
- flattened (flexed) lumbar spine
- posteriorly tilted pelvis
- hip joint in extension
- knee slightly flexed
- ankles slightly dorsiflexed

McGill (2002) observed a group of men suffering chronic lower back pain doing squat like movements. Subsequently, McGill (2002) described the failure to recruit muscle fibre's within the gluteals as gluteal amnesia which therefore increases and overloads the lower back muscles, causing stress.



Sway Back

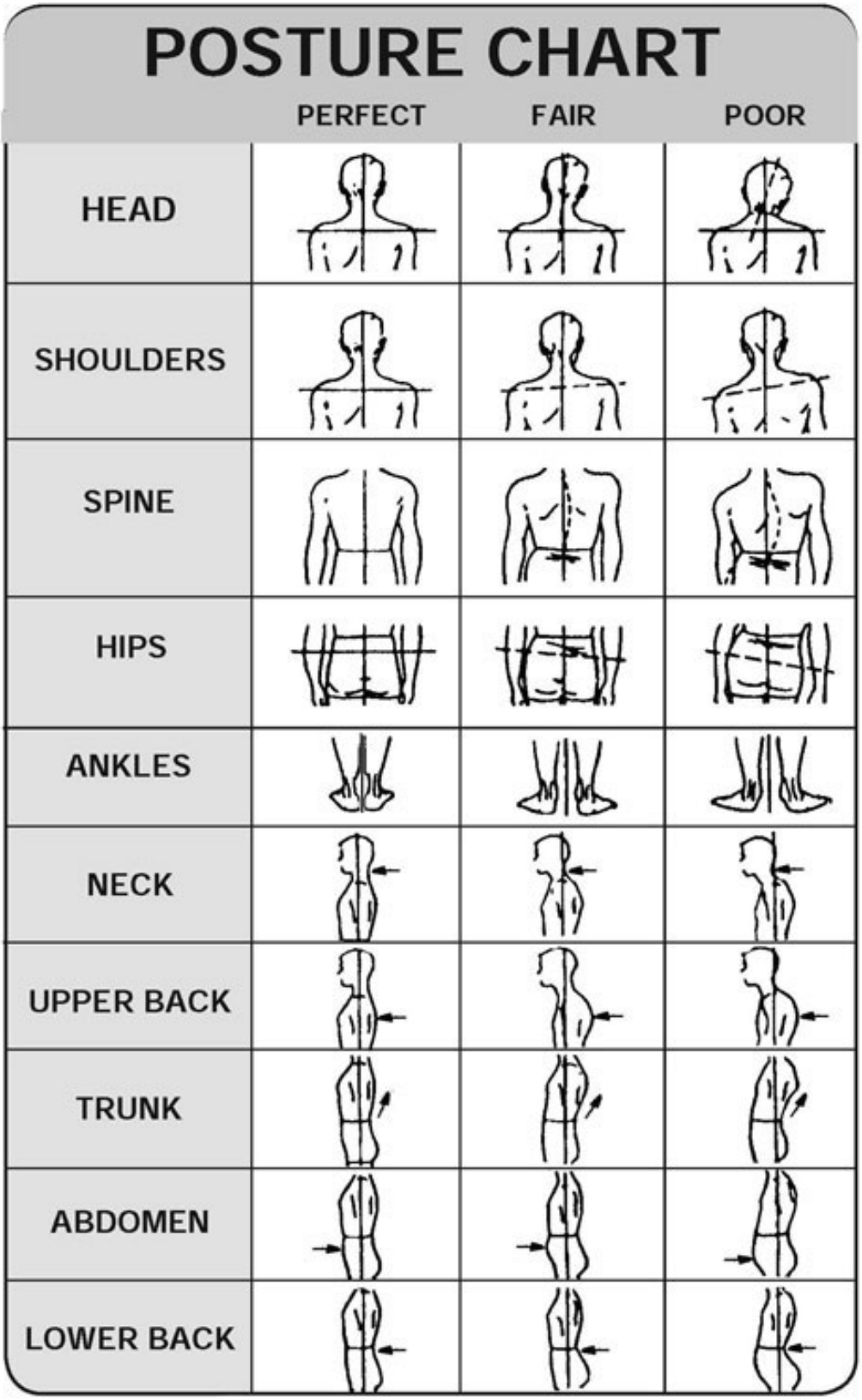
A sway back position is so called because the pelvis translates, or sways forward of the body. This creates the following specific postural characteristics:

- forward head carriage
- slightly extended cervical spine
- increased thoracic curvature
- flattened (flexed) lumbar spine
- posteriorly tilted pelvis
- hip joint in extension
- knee slightly flexed
- ankles slightly dorsiflexed

A major cause of spinal deviations is repeated movements and patterns, as well as repeated behaviour. There has been a national average of a 17% rise in back and neck pain across the UK, with some regional areas showing increases above 12% of that.

Developing and being able to make objective and effective postural observations takes time and lots of practice. With more practice, the more the therapist's 'eye' will be developed and the more familiar each element of a postural assessment becomes, enabling them to judge correctly and to determine the degree of severity of each positional dysfunction.

In the early stages of developing postural assessment skills it is quite common to observe each element of the assessment in isolation and whether a particular deviation is simply present or not. It is advantageous to become competent in observing each element of a postural assessment so that it becomes second nature. It can aid exercise prescription as well as goals.

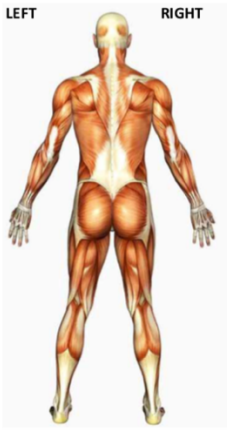


There can also be many things that can affect posture and pain on a client. Some conditions such as:

- Sacroiliac Joint Dysfunction
- Facet Joint Irritation
- Spondylolisthesis

Advice

The majority of advice that could be given stems from asking patients to question how they sit or how they sit whilst driving. Some simple guidelines to help improve posture may eliminate or ease some of the problems they are experiencing.
When completing paperwork record details as full as possible.

POSTERIOR VIEW		
ANGLES OF SCAPULA:	LEFT RIGHT 	SCOLISOSI:
AEAR LEVEL/TILTED HEAD:		PSIS LEVEL:
KNEE LEVEL:		THERAPIST NOTES:

Annotate on diagrams to give a clear indication of areas of interest.

Range of movement (ROM)

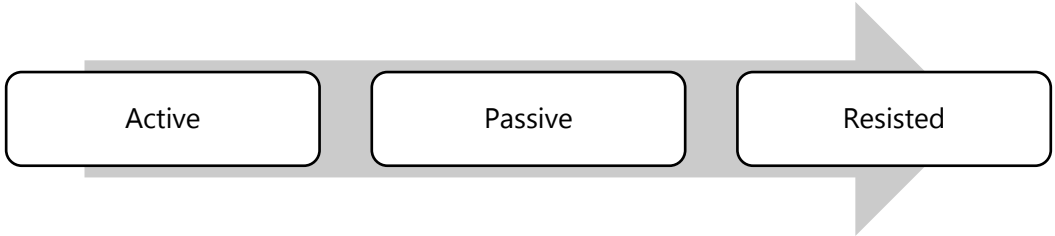
Joint ranges of movement

When testing the ROM at the joints the client is always asked to perform all the active movements first as this:

- puts the client in control of themovement
- allows the client to move within their pain tolerance
- allows the client to cease a movement if they experience too much discomfort

It also allows the sports massage practitioner to:

- observethenaturalmovementbeingperformed and any compensations made
- observe any guarding of movement due to expectation of pain
- observe any pain responses



ROM assessments need to be performed in a logical and appropriate fashion to ensure they are progressive. The therapist then takes the joint passively through its range of movement where the quality of movement can be felt (areas of ease or 'snagging'.) This is a skill that develops over time and with experience.

During active testing, pain may be experienced in the contracted muscle (the agonist) or in the muscle that is being stretched by the contracting muscle (the antagonist). If the client reports pain the therapist must ask the client to indicate where pain is felt.

The therapist then takes the joint passively through its range of movement where the quality of movement can be felt (areas of ease or 'snagging'). This is a skill that develops with experience. The end of range ('end feel') can be what is bringing the movement to a stop (bone-to-bone contact, joint capsule, ligaments, muscles or tendons). Passive testing also isolates non-contractile structures. There is no muscle contraction, but passive stretching of the joint may elicit pain as the ligaments or joint capsule are stretched/stressed.

When passive testing, the muscle's 'point of bind' (when resistance is first felt/sensed as it lengthens) can be felt which indicates the length of the muscle. It also assesses the end range response of the muscle (springy, firm, spasm, cramp).

Resisted testing is only carried out after active and passive movements and if the pain experienced during these is below a 5 out of 10. Contractile structures are assessed with resisted movements i.e. with knee flexion the knee moves from extended to flexed positions, with the therapist giving resistance against the movement. This identifies how well increasing the resistance can be tolerated, poor recruitment ability, weakness in muscles or muscle groups (particularly imbalances) and any pain response.

Interpreting results

All ranges of movement (ROM) can be compared against theoretical normal or recognised ROM gained through experience of assessing clients. Most importantly, the results should be compared to the functional requirements of the client and relevant factors in their history. Balance and imbalance from left to right and anterior to posterior should be identified so the presentation of unilateral dysfunction and compensatory movement due to reduced ROM can be identified.

Relevant objective assessment findings should be connected to subjective results in order to extract as much information as possible. This will build a clearer picture of why they client may be presenting with their current condition.

JOINT	ROM
Spine	Flexion, extension, rotation (*active only), lateral flexion
Hip	Flexion, extension, abduction, adduction, medial rotation, lateral rotation
Shoulder	Flexion, extension, abduction, adduction, medial rotation, lateral rotation
Knee	Flexion, extension, medial rotation, lateral rotation
Ankle	Plantar flexion, dorsi flexion, eversion, inversion
Elbow	Flexion, extension, pronation, supination
Wrist and hand	Flexion, extension, ulnar deviation, radial deviation, abduction and adduction (fingers)

Palpation

Part of the Sports Massage Therapist skill set is the use of palpation to determine tenderness, aid identification of abnormalities and dysfunction, feelings of heat and tenderness. It is also a very effective and useful tool for examining soft tissue and bony landmarks.

Using the therapist's touch, palpation is half art and half science, with the skill taking time and experience to develop along with a sound comprehension of anatomy and physiology.

Palpation provides valuable information on the current condition of a client's soft tissue physical condition, identifying possible areas of difference, abnormalities, tension and trigger points which may be factors contributing in the loss of function and pain.

Using palpation helps to connect the subjective and objective assessments, providing specific assessment within the reported areas of dysfunction and pain. The main purpose is to aid the identification of anatomical sites that are involved in functional movements and the sites of dysfunction. It is important to talk through the process with the client to reduce stress levels as well as muscular tension to improve the accuracy of the palpation and findings.

The presence of absence of any symptom(s) are of equal importance and both should be recorded. Asking open and closed questions with good communication will help clarify any findings. Consistent feedback is important if the centre of trigger points etc are to be located.

Several techniques can be employed during palpation,

Technique	Direction
Finger Pads	The pads of the fingers are moved across the landmark – ensure nails are well kept and cut, or this can cause discomfort.
Flat Finger	Using the fingertips to slide around the patient's skin across muscle fibres. More superficial than other techniques.
Pincer	Pinch the belly of the muscle between the thumb and other fingers, rolling the muscle back and forth in a rolling motion.
Flat hand	A lot of use in the abdominal region, the hand is placed flat on the landmark.
Elbow	A strong, short lever which can be a little difficult with dexterity, however the strength can be an advantage. Not used very often
Back of fingers and hand	The back of the fingers and hands are used to check the body temperature. Since the skin is thinner at this location, it can easily determine whether a body part is cool, cold, warm or hot.

Palpation is a difficult skill to master. It can be used to identify things such as:

- Identify changes in any soft tissue structures and difference between pairs
- Identify changes in temperature
- Identify musculoskeletal structures and bony prominences (vital to help navigate around the body).

Once a level of skill/proficiency has been developed a Sports Massage Therapist could detect and identify some of the following:

- Changes of temperature – excess heat could indicate higher than normal metabolic activity and show signs of inflammation and in reverse feelings of cold could indicate lower than normal metabolic activity, such as a muscle spasm.
- Tension in the skin and soft tissue – areas of dysfunction cause the skin to feel tense and exhibit a resistance.
- Tenderness
- Lack of elasticity – skin in unable to recoil/spring back when lightly stretched.

Functional tests

The aim of any functional test is to identify how a client's current condition can be affecting their daily life. Asking a client to perform simple or complex movements that mimic every day and daily tasks ensure that the extent of the dysfunction/pain is tests specifically to their needs. Evaluating and gaining a true reflection helps to prepare for appropriate testing and treatment.

For simple, none exercise based movements, minimal intervention is needed by the therapist. This can give a clear indication of adaptive movements that have developed or their pain responses.

ADL	Functional test	Related exercise	Observing for:
Walking up steps Getting into or out of a bath/shower Getting into or out of a car	Stepping onto a bench or chair.	Single leg / pistol squat	Dorsiflexion, knee positioning (genu varus/ valgus), lateral tilting of pelvis. upper body inclining forwards
Getting up off a chair, settee or bed Sitting on a bench or chair	Raise to Standing from a chair Sitting from a standing position onto a chair.	Squat	Ankle dorsiflexion, knee positioning (genu varus/ valgus), pelvis moving across laterally one side, upper body inclining forwards
Reaching for high shelf Reaching overhead, putting your shopping on shelving or brush hair	Raising a hand up to a specified point by the Sports Massage Therapist.	Overhead press	Upper body movement, guarding movements during action

The more accurate and detailed the recording of the client's assessment the more useful it will be to the therapist. The treatment records also serve as a vital document should the client need to be referred or they have any detrimental or less than desirable side effects to treatment.

Client Records

All client records must be completed within 24 hours of the treatment and appointment, if not immediately. Records should be stored with the following guidelines of:

- Keep for 8 years if the client is an adult
- Keep for up to 25 years of age if the client is under 18 at the time of treatment
- Store in accordance with GDPR regulations

Devising a Treatment Plan

Once both the subjective and objective assessments have been completed, the next stage is to devise, discuss and agree a treatment plan that satisfies the client and is suitable for their needs.

During the subjective assessment the client will outline what they want from the treatment which provides an understanding of the best type of treatment to suit their preferences.

It is important to explain the techniques that can be used and the effects they have, including issues such as bruising and discomfort. Positive factors and potential consequences/ negatives should be provided so that the client can give informed consent.

When agreeing on a plan, the goals of the treatment and proposed methods should be recorded on the client's record and documentation. Proposed actions are divided into therapist treatment and possible exercises and techniques that can be performed at home. This will aid future treatments and enhance the long-term plan.

Evaluating Treatments

It is important to evaluate the success of treatments. This can be carried out in a number of ways:

- Performing re-assessments to compare results, specifically functional tests and ROM. This type of assessments offer can offer evidence just how much a client has benefited from the treatment. It is important to ensure the tests are carried out in exactly the same manner or it will not hold as much value.
- Asking directly for client feedback upon the conclusion of the session. This has to be approached upon an individual level as often these can be false due to a client feeling under pressure. Clients that have a good rapport with the therapist and are confident in nature will give both positive and negative feedback. If this is carried out at the time of treatment, less external factors have the opportunity to influence it.
- Self – Reflection. A highly valuable practice, it allows a Sports Massage Therapist to highlight areas of future CPD or needs, where they feel there is weakness within their skill sets. If used with other forms of feedback it can give the therapist a solid base to help the future development of their practice. It can also highlight equipment and update needs. However, the feedback could be bias and to suit a personal interest or investment.
- Asking clients to give confidential / anonymous feedback via comments books, cards via email, waiting room or letter. This gives those less confident a fair and equal opportunity to offer their thoughts and feedback. This method is more susceptible to external influences, such as hearing others in a waiting room or reading articles for example.
- Asking for feedback at a later date, such as at next session or upon a conclusion of a long-term plan.

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