

London School of Massage



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Skeletal System

At the end of this section you will understand and appreciate:

- Names of bones making up the skeleton
- Structure and function of the skeleton
- Classification of bones
- Growth of bones
- Classification of joints
- Conditions affecting the skeletal system
- How massage affects the skeletal system

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The Skeletal System

The human skeleton is made up of **206** bones and can be divided into two parts:

- **Axial Skeleton** – Skull, spine ribs and sternum
- **Appendicular Skeleton** – includes the limbs, “arms and legs”



FUNCTIONS OF THE SKELETON

The skeleton provides the framework for the body and has 6 principal functions. These are:

It:

1. Provides shape and **SUPPORT** for the body
2. Provides **JOINTS** where movement takes place
3. Provides areas of **ATTACHMENT** for muscles
4. Provides **PROTECTION** for vital internal organs, e.g.
 - **Pelvic Girdle** - reproductive organs, bladder, intestine etc.
 - **Thorax & Ribs** - heart and lungs
 - **Skull** - brain
5. Manufactures **Erthrocytes (Red Blood Cells)** in red bone marrow
6. Provides **calcium** reserves

COMPOSITION OF BONE

Bone is a dry dense tissue composed of approximately:

25% Water

30% Organic material -fibrous material → toughness and resilience

45% Minerals - mainly calcium and phosphorus salts → rigidity and hardness

Bones are living tissue made from cells called **osteoblasts**.

Bones are broken down by cells called **osteoclasts**.

Most bones have a central cavity containing marrow, which is the site of manufacture for most blood cells. The marrow is also a site for storage of fat.

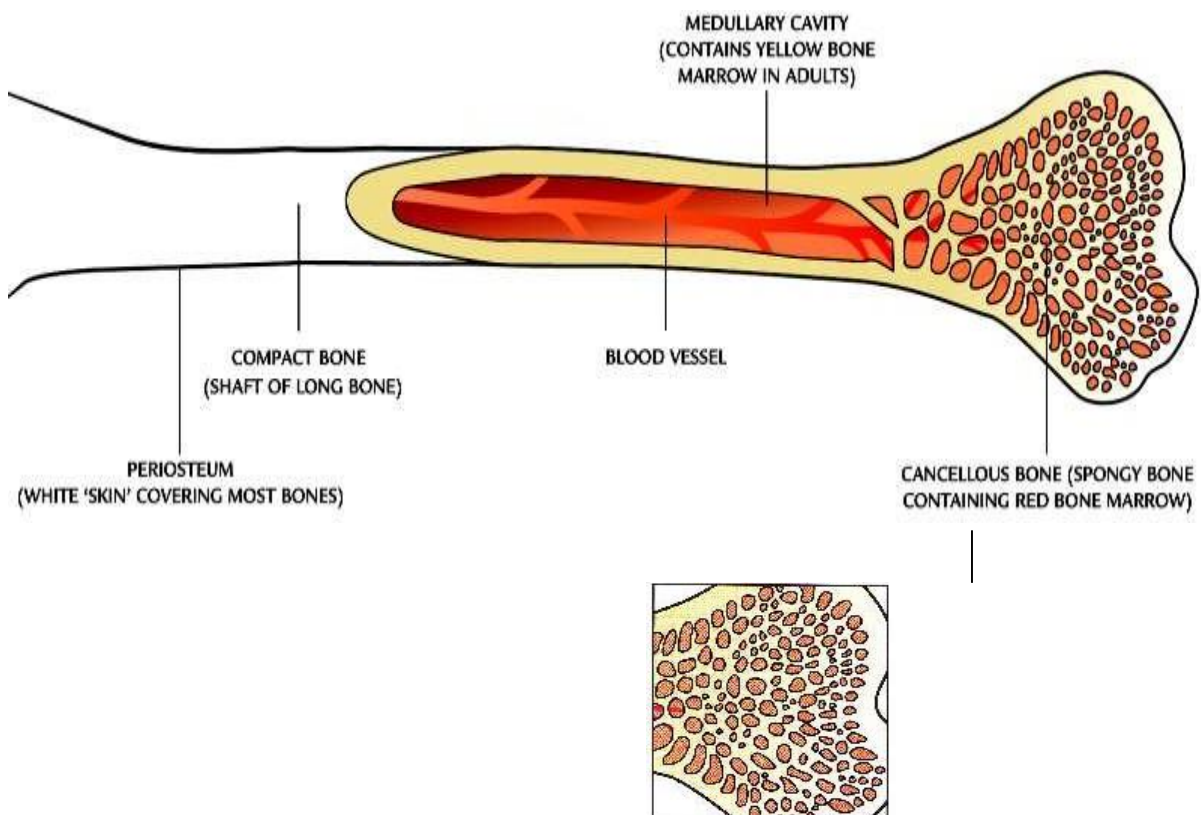
There are two main types of bone.

1. COMPACT (HARD) BONE

- This is dense bone tissue containing few spaces.
- Under the microscope, its structure resembles a honeycomb shape. These are called the **Haversian Canals** through which pass **blood vessels, lymph capillaries** and **nerves**.
- It is deposited in a layer over the spongy bone tissue.
- **It is found on the outside of most bones and in the shaft**

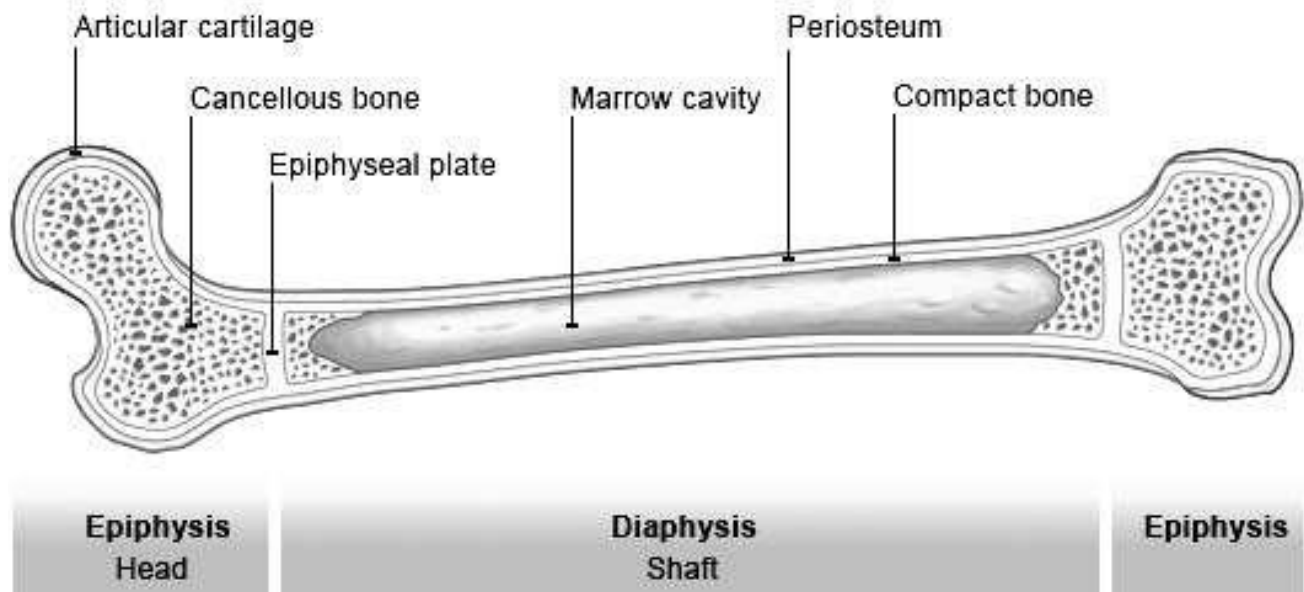
2. CANCELLOUS (SPONGY) BONE

- This type of bone looks like a sponge
- **Is found at the ends of a long bone and in flat, and irregularly shaped bones**
- Red bone marrow only exists in cancellous bone



Both type of bone tissue is found in ALL bones in the body in different proportions.

HOW BONES GROW



Epiphysis - the 'head' of the bone.

Epiphyseal plate – the area where bones grow in length.

Diaphysis - the shaft.

Long bones have bands of cartilage on the ends called epiphyseal plates.

During the growing process, Human Growth Hormone (HGH) from the pituitary gland stimulates the chondrocytes to reproduce, creating new cartilage and lengthening the bone. Osteoblasts then move in and ossify the newly formed cartilage into bone. This process continues through puberty. Once puberty is complete, the epiphyseal plates fuse, and the bone no longer grows in length.

THE SKELETON

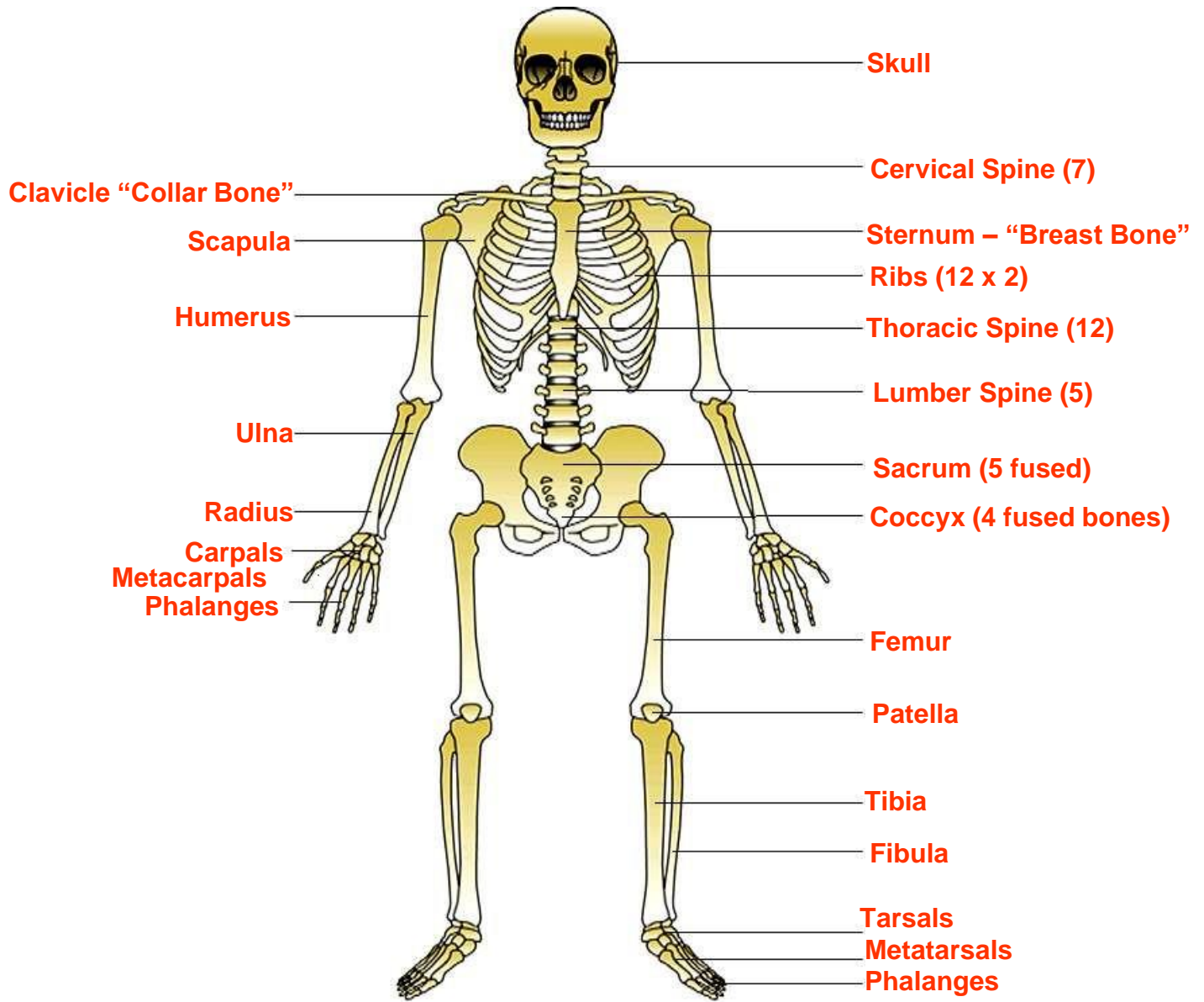


Diagram of the Skeleton

PELVIS

The Pelvis is made up of 2 **Innominate** bones and **sacrum**.
Each innominate bone is made up of 3 **FUSED** bones called:

1. Ilium (iliac)

2. Ischium (ischial)

3. Pubis (pubic)

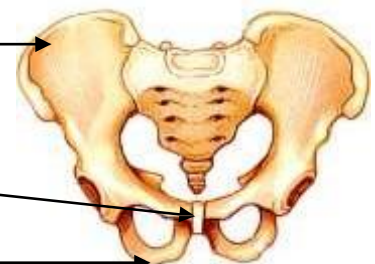


Side view

Ilium

Pubis

Ischium



Anterior view

BONES OF THE BODY

There are **206** bones in the body.

SKULL 22 bones

SPINE 24 moveable bones and 9 fused bones

- 7 Cervical ,
- 12 Thoracic,
- 5 Lumbar,
- 5 Sacrum (fused)
- 4 Coccyx (fused)

THORACIC CAGE 12 Ribs each side
Sternum (3 bone – Manubrium, Sternum, Xyphoid Process)

SHOULDER GIRDLE 4 bones (two on each side - scapula & clavicle)

UPPER LIMB 30 bones on each side (60 altogether)

- Humerus
- Radius
- Ulna
- 8 carpal bones
- 5 metacarpal
- 14 Phalanges

PELVIS Formed by 4 bones

- 2 Innominate bones (each made up of ischium, ilium, pubis)
- Sacrum,
- Coccyx

LOWER LIMB 30 bones on each side (60 altogether)

- Femur
- Tibia
- Fibula
- Patella
- 7 Tarsal bones
- 5 metatarsal
- 14 Phalanges





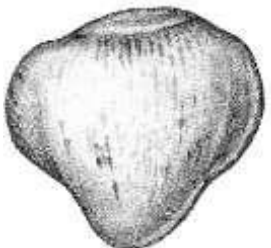
In addition to the above, there is also the **hyoid bone, which sits**, detached in the neck

Better way to remember the bones is to memorise them on your own body.

Body Movements Practice Sequence

Area	Movement	
Cervical Spine	<ul style="list-style-type: none"> ▪ Flexion ▪ Extension ▪ Side bending left ▪ Side bending right ▪ Rotation left ▪ Rotation right 	<p>Sternocleidomastoid (SCM), Platysma</p> <p>Upper Trapezius, Levator Scapula, SCM, CES (both sides contracting)</p> <p>Upper Trapezius, Levator Scapula, SCM, CES (both sides contracting)</p> <p>Upper Trapezius, Levator Scapula, SCM, CES (both sides contracting)</p> <p>SCM</p> <p>SCM</p>
Whole Spine	<ul style="list-style-type: none"> ▶ Flexion ▶ Extension ▶ Side bending left ▶ Side bending right ▶ Rotation left ▶ Rotation right 	<p>Rectus Abdominus, External Oblique, Internal Oblique, Transversus Abdominis</p> <p>Erector Spinae, Trapezius, Latissimus Dorsi, Quadratus Lumborum</p> <p>Erector Spinae, Trapezius, Latissimus Dorsi, Quadratus Lumborum</p> <p>Erector Spinae, Trapezius, Latissimus Dorsi, Quadratus Lumborum</p> <p>External Oblique, Internal Oblique,</p> <p>External Oblique, Internal Oblique,</p>
Shoulder	<ul style="list-style-type: none"> ▪ Flexion ▪ Extension ▪ Abduction ▪ Adduction ▪ External / Lateral Rotation ▪ Internal / Medial Rotation ▪ Circumduction 	<p>Pectoralis Major, Coracobrachialis, Ant. Deltoid, Biceps Brachii, Post. Deltoid, Latissimus Dorsi, Triceps</p> <p>Middle Deltoid, Supraspinatus</p> <p>Pectoralis Major, Latissimus Dorsi, Infrapinatus, Teres Minor, Post. Deltoid,</p> <p>Pectoralis Major, Latissimus Dorsi, Subscapularis, Teres Major</p> <p>Combination of all the above muscles</p>
Elbow	<ul style="list-style-type: none"> ▶ Flexion ▶ Extension ▶ Supination ▶ Pronation 	<p>Brachialis, Biceps Brachii, Brachioradialis</p> <p>Triceps</p> <p>Biceps Brachii, Supinator</p> <p>Pronator Teres</p>
Hand	<ul style="list-style-type: none"> ▪ Flexion ▪ Extension ▪ Abduction ▪ Adduction 	<p>Flexor Carpi: Ulnaris, Radialis & Digitorum</p> <p>Extensor Carpi: Ulnaris, Radialis & Digitorum</p> <p>Extensor Carpi Radialis and Flexor Carpi Radialis</p> <p>Extensor Carpi Ulnaris and Flexor Carpi Ulnaris</p>
Fingers	<ul style="list-style-type: none"> ▶ Flexion ▶ Extension ▶ Abduction ▶ Adduction 	<p>Flexor Carpi Digitorum</p> <p>Extensor Carpi Digitorum</p> <p>- not needed</p> <p>- not needed</p>
Hip	<ul style="list-style-type: none"> ▪ Flexion ▪ Extension ▪ Abduction ▪ Adduction ▪ External / Lateral Rotation ▪ Internal / Medial Rotation ▪ Circumduction 	<p>Psoas, Iliacus, Rectus Femoris, Sartorius</p> <p>Gluteus Maximus</p> <p>Gluteus Maximus, Gluteus Medius Gluteus Minimus</p> <p>Adductor: Brevis, Longus Magnus, Gracilis</p> <p>Gluteus Maximus, Sartorius</p> <p>Gluteus Medius, Gluteus Minimus</p> <p>Combination of the above muscles</p>
Knee	<ul style="list-style-type: none"> ▶ Flexion ▶ Extension 	<p>Hamstrings: Biceps Femoris, Semitendinosus, Semimembranosus, Gastrocnemius</p> <p>Quadriceps: Rectus Femoris, Vastus: Lateralis, Intermedius, Medialis,</p>
Ankle	<ul style="list-style-type: none"> ▪ Dorsi Flexion ▪ Planter Flexion ▪ Inversion ▪ Eversion 	<p>Tibialis Anterior, Extensor Digitorum,</p> <p>Gastrocnemius, Soleus, Peroneus Longus, Flexor Digitorum</p> <p>Tibialis Anterior</p> <p>Peroneus Longus</p>
Toes	<ul style="list-style-type: none"> ▶ Flexion ▶ Extension ▶ Abduction ▶ Adduction 	<p>Flexor Digitorum</p> <p>Extensor Digitorum</p> <p>- not needed</p> <p>- not needed</p>

TYPES OF BONES

Type	Function / Location	Diagram
1. Long	<ul style="list-style-type: none"> Provides Body Levers Allows movement <p>Examples:</p> <ol style="list-style-type: none"> <u>Femur</u> <u>Humerus</u> <u>Tibia & Fibula</u> <u>Metacarpals & metatarsals</u> <u>Phalanges</u> 	
2. Short	<ul style="list-style-type: none"> Usually compact & grouped <p>Examples:</p> <ol style="list-style-type: none"> <u>Carpel bones</u> <u>Tarsal bones</u> 	
3. Flat	<ul style="list-style-type: none"> Protective bone Have a flat area for muscle attachment <p>Examples:</p> <ol style="list-style-type: none"> <u>Scapula</u> <u>Sternum</u> <u>Ribs</u> <u>Nasal bones</u> <u>Innominate</u> 	
4. Irregular	<p>Irregularly shaped Do not fit into above categories</p> <p>Examples:</p> <ol style="list-style-type: none"> <u>Vertebra</u> <u>Mandible</u> <u>Maxilla</u> 	
5. Sesamoid	<p>Shaped like a sesame seed Bone lies within the tendon of a muscle</p> <p>Examples:</p> <ol style="list-style-type: none"> <u>Patella</u> <u>Hyoid</u> <u>Pisiform</u> 	

THE SKULL

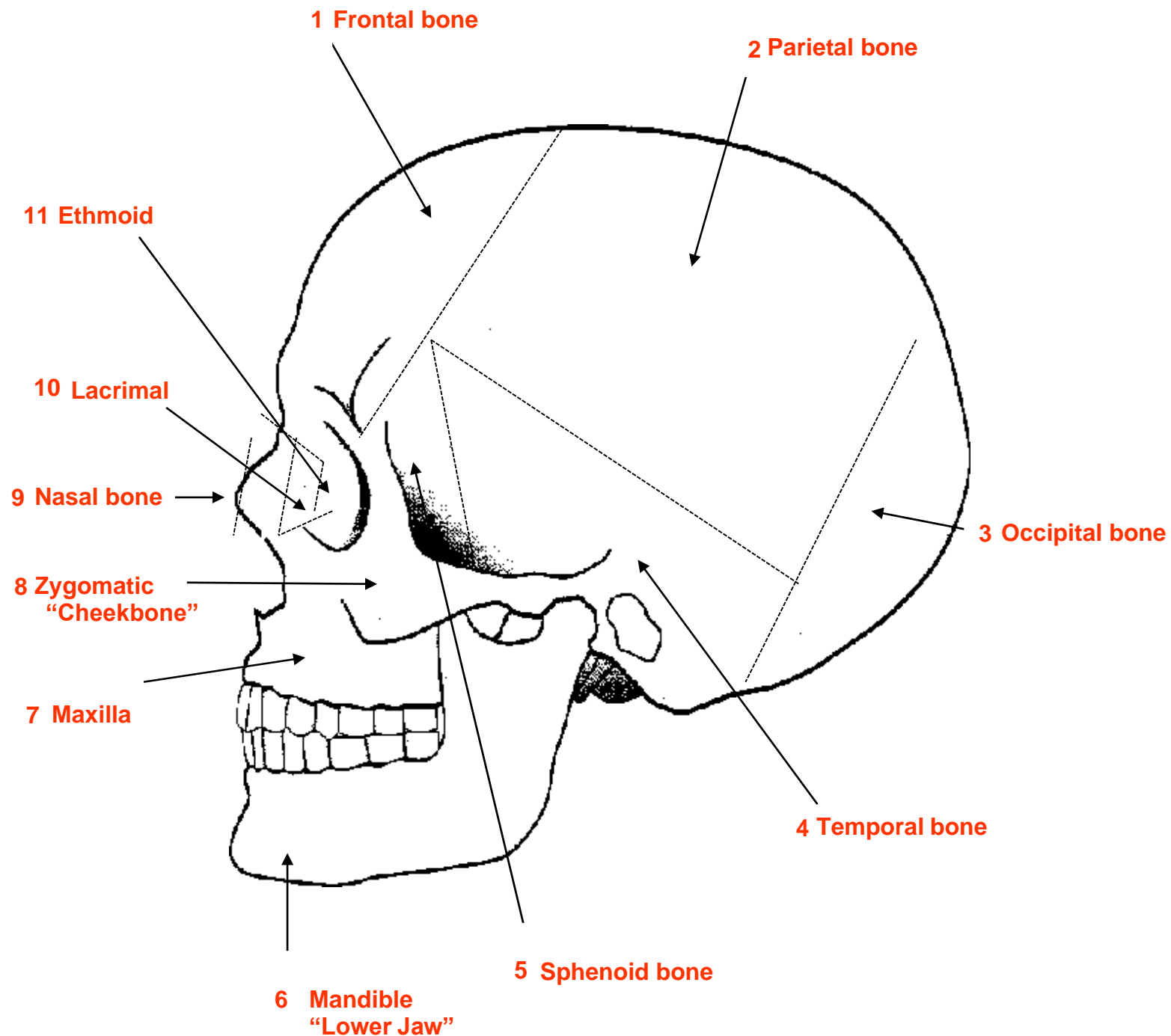
The skull is made up of the

1. Cranial Bones (Cranium)

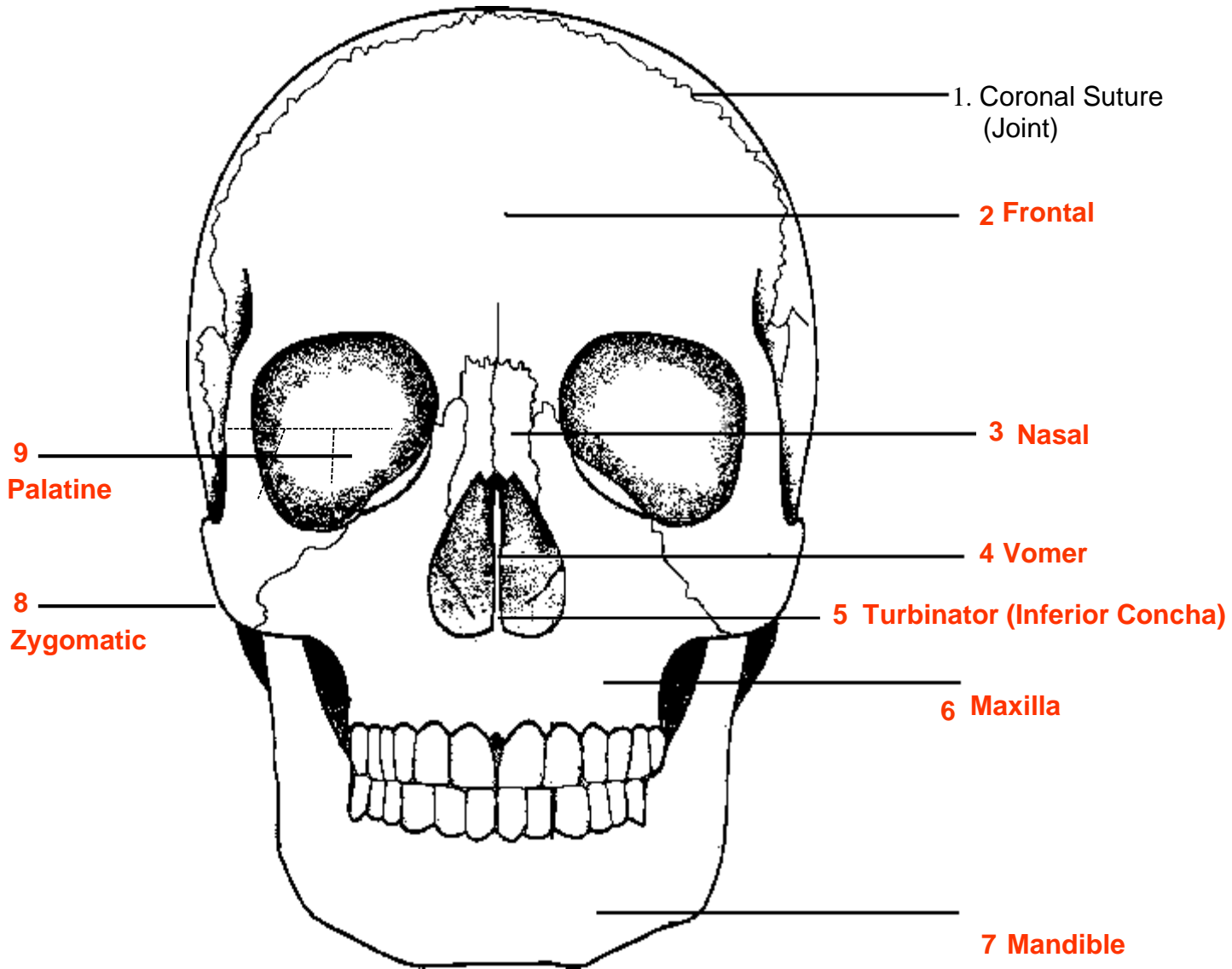
• Parietal • Frontal • Ethmoid • Sphenoid • Occipital • Temporal

2. Facial Bones

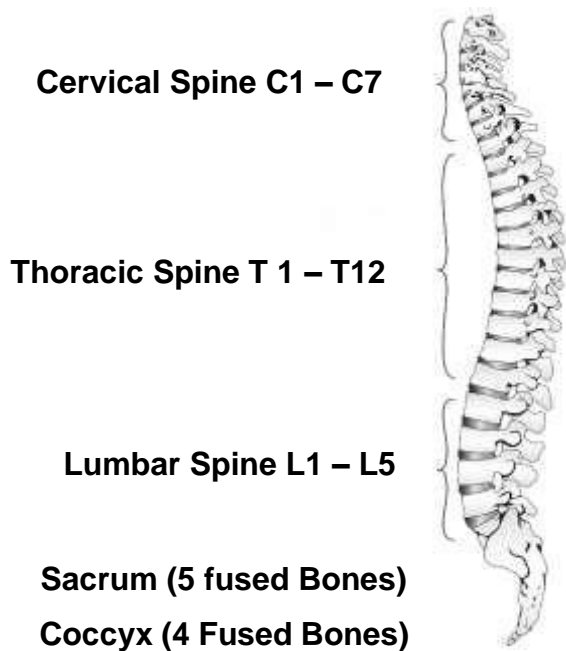
• Nasal • Zygomatic • Maxilla • Lacrimal • Turbinator • Palatine • Mandible • Vomer • Hyoid



(Hyoid bone lies in the upper neck region – not shown)

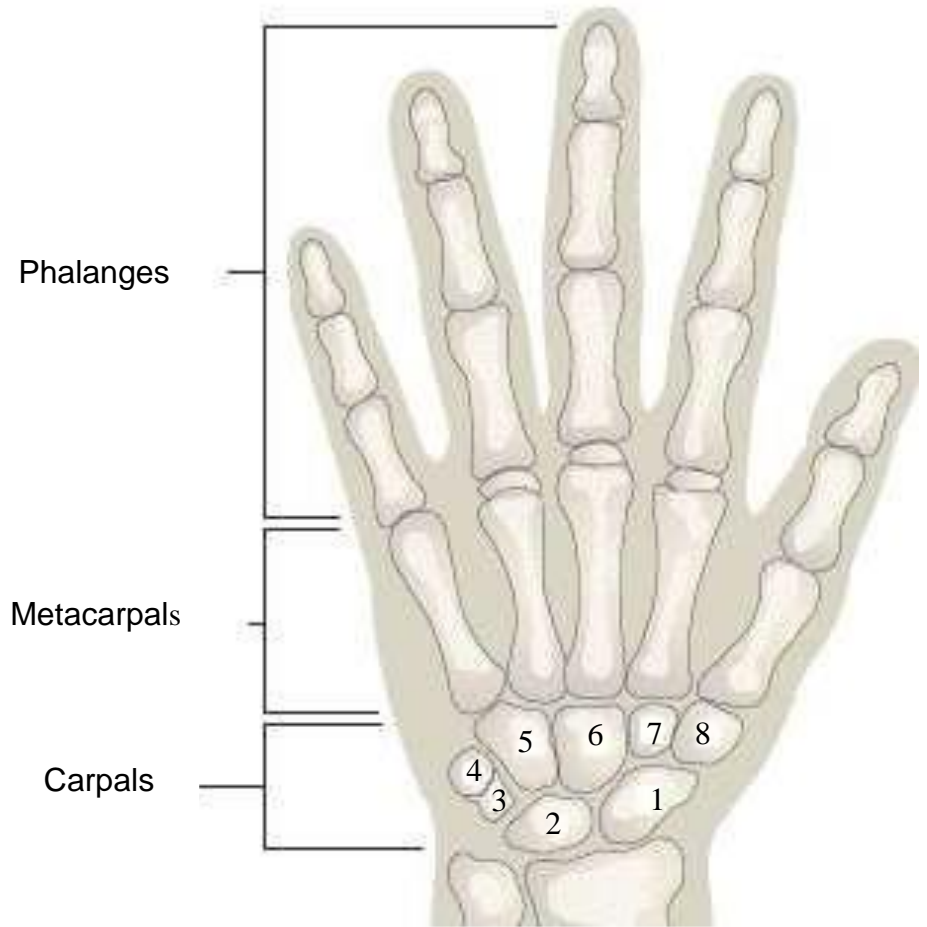


Anterior View: Bones of the Skull (refer to course book)



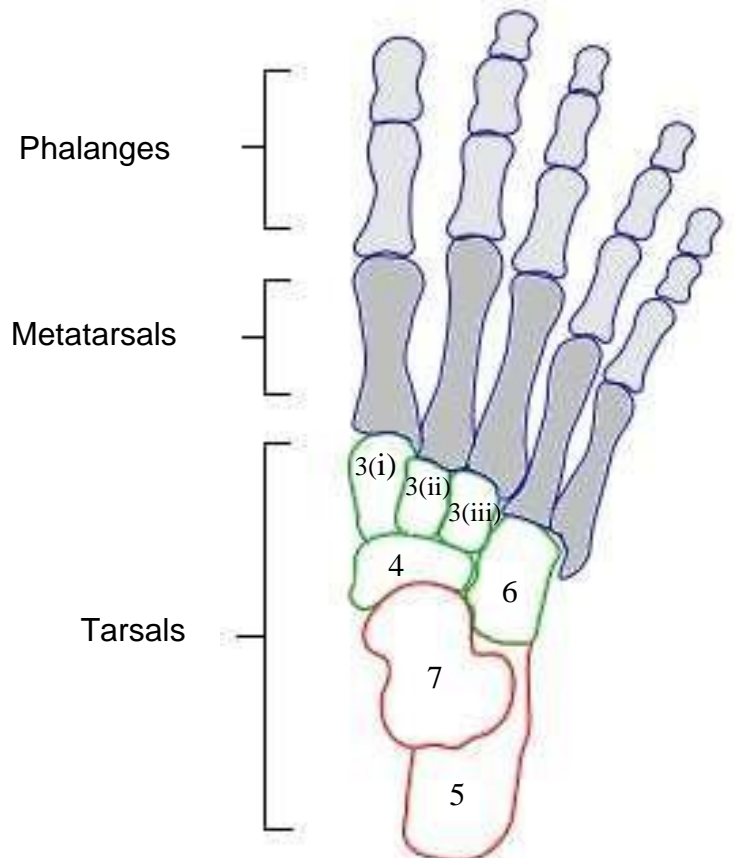
The Spine

	Carpal Bone	Mnemonic
1	Scaphoid	
2	Lunate	
3	Triquetrum	
4	Pisiform	
5	Hamate	
6	Capitate	
7	Trapezoid	
8	Trapezium	



Bones of the Right Hand – Anterior View (refer to course book)

	Tarsal Bone
1	Cuneiform
2	i. Medial
3	ii. Middle
	iii. Lateral
4	Navicular
5	Calcaneus
6	Cuboid
7	Talus



Bones of the right foot – dorsal view

JOINTS

A joint is formed where 2 bones meet and is held by **LIGAMENTS** which give the joint its stability.

They may be simply classified into 3 types.

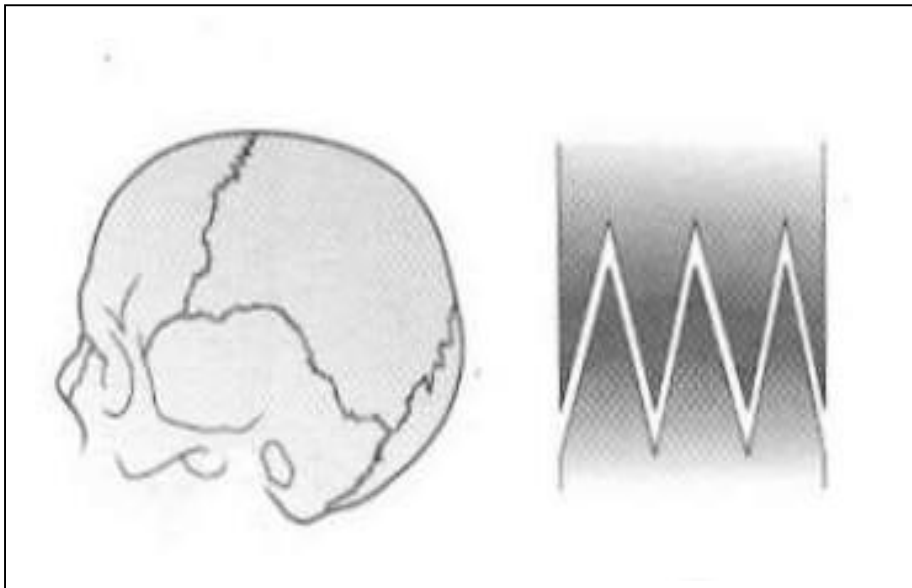
1. FIXED JOINTS / FIBROUS

No movement is permitted.

Fibrous tissue in-between the joints,

Example:

- Sutures of the skull

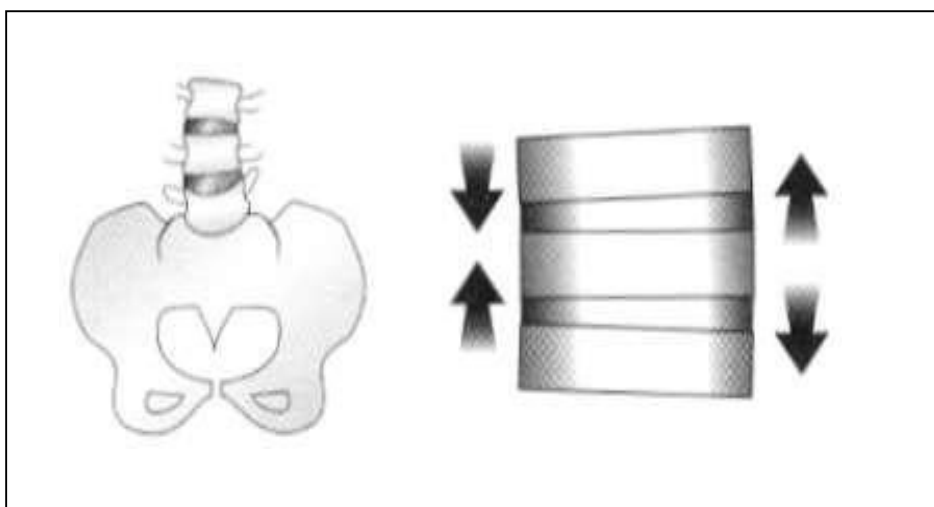


2. SLIGHTLY MOVABLE JOINTS / CARTILAGINOUS

Bones are held by strong ligaments

Example:

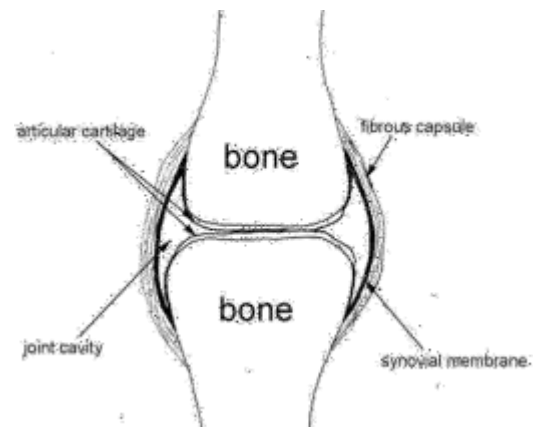
- Intervertebral joints
- Symphysis pubis
- Sacro-iliac joints joint









3. FREELY MOVABLE JOINTS (SYNOVIAL JOINTS)

A synovial joint is a joint which:

- Is freely moveable
- Has capsule lined with **SYNOVIAL MEMBRANE**
- Has **SYNOVIAL FLUID** in the joint.



There are 6 different types:

Joint	Example	Movements
	Ball & Socket: Hip shoulder	Flexion Extension Abduction Adduction Rotation Circumduction
	Hinge elbow knee ankle between phalanges	Flexion Extension
	Gliding Inter tarsal / carpal bone articulation	Small gliding movements
	Condyloid Wrist joint Lower jaw (TMJ – Tempromandibular Joint)	Allow movements in two planes
	Pivot atlas and axis (C1 & C2 articulation), proximal radius & ulna	Rotation
	Saddle: 1 st metacarpal and trapezium articulation (thumb)	Flexion Extension Abduction Adduction Circumduction

CONDITIONS AFFECTING THE SKELETAL SYSTEM

1. SPINAL CURVATURES

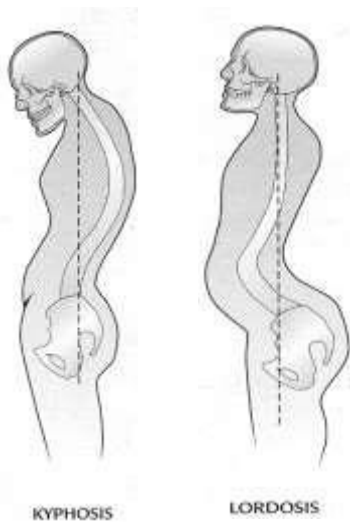
The body has natural curves, which help reduce stresses on bones and joints. When these become exaggerated they can give rise to postural deformities.

There are 2 ways you can look at the spine and the body:

1. LATERAL VIEW (SIDE LINE VIEW)

In this view there are 2 types of curves that can be seen. These are:

- a. **KYPHOSIS:** this is an **outward** curvature of the spine – thoracic spine
- b. **LORDOSIS:** - this is an **inward** curvature of the spine lumbar spine & cervical spine



Some Causes of Kyphosis & Lordosis

Congenital: Present at birth

Environmental:

Poor posture (stooping) - Kyphosis
High heels - lordosis

Traumatic: Fracture of a vertebra

2. POSTERIOR VIEW

In this view 1 type of curvature can be seen.

- a. **SCOLIOSIS** – sideways curvature and can occur in any part of the spine.

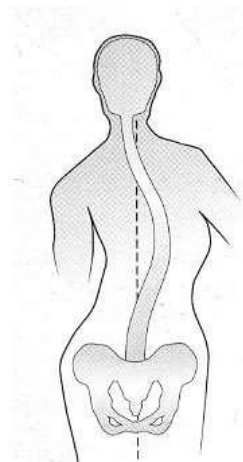


Diagram of a scoliosis

Some causes of a Scoliosis are:

Congenital: Present at birth

Environmental: Carrying a heavy bag on one side

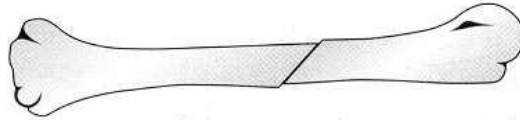
Traumatic: Fracture of one leg

2. FRACTURES

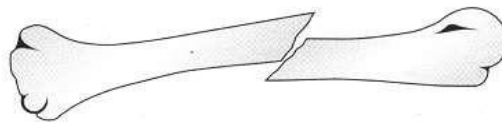
Fracture = a break in a bone

- They are divided into 6 different types:

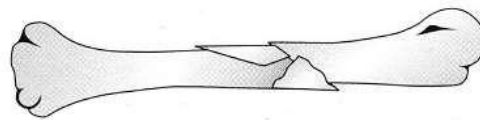
1. **Simple fracture** - bone broken in one place, but no serious damage to surrounding tissue occurs.



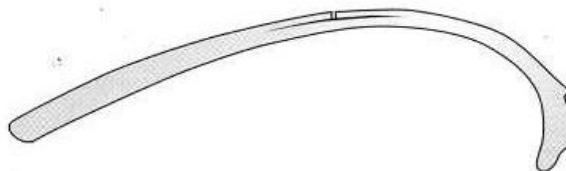
2. **Compound fracture** - bone is broken and protruded through the skin.



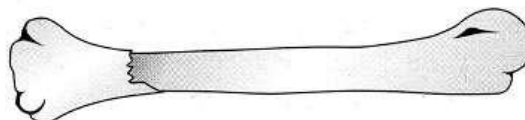
3. **Comminuted fracture** - bone is broken in several places.



4. **Greenstick fracture** - this is an incomplete fracture of a long bone and commonly seen in children.











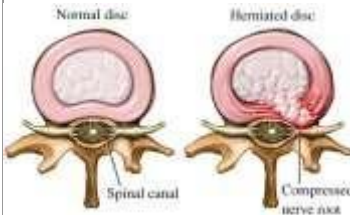

5. **Impacted fracture** - ends of broken bone are driven into each other.











6. **Complicated fracture** - bone is broken and breaks causes injury to surrounding soft tissue.

DISORDERS AND DISEASES OF THE SKELETAL SYSTEM

Condition	Cause	Effect	Picture
Arthritis	“Arth” = joint, “itis” = inflammation	Symptoms may be acute and show signs of inflammation which are: <ol style="list-style-type: none"> 1. <i>Redness</i> 2. <i>Heat</i> 3. <i>Swelling</i> 4. <i>Pain</i> 	
Ankylosing Spondylitis	Autoimmune disease which affects the spine	Acute and chronic phases which result in fusion of the joints of the spine causing severe deformity and immobility	
Cancer	The exact causes of primary bone cancer are unknown. Many bone cancers occur in teenagers and young people, it is thought that they may be related in some way to changes that occur when bones are growing.	Pain Swelling Problems with movement	
Carpel Tunnel Syndrome	Compression of the median nerve in the Carpal Tunnel of the hand	Pain loss of sensation in the lateral 3 digits. Also loss of power.	
Ganglion	A ganglion is a benign cyst. It most commonly occurs next to the wrist. It is usually harmless but can be unsightly.	Can cause a little discomfort in the hand.	

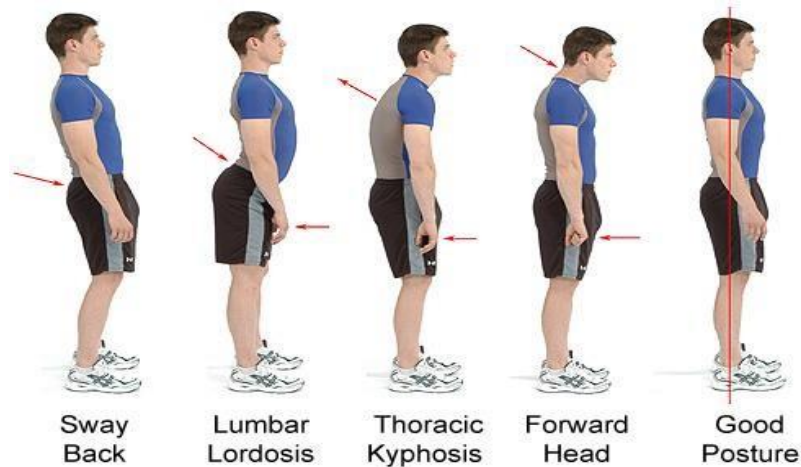
Condition	Cause	Effect	Picture
Gout	Deposition of uric acid crystals within the joint capsule and cartilage	Attacks of acute gouty arthritis chronic destruction of joints	
Osteoarthritis	May be injury of the joint or, if widespread, may be associated with the ageing process	Chronic arthritis of degenerative type – cartilage of joint breakdown; usually affects weight bearing joints like knees, feet and back	
Osteoporosis	Calcium deficiency; accelerated bone loss especially in post-menopausal women	Porosity and brittleness of bones	
Prolapsed Intervertebral (slipped) disk	The weakening or tearing of one of the intervertebral discs	Disc bulges or sticks out and this may press on the spinal nerve causing pain	
Stress	Stress is any factor, which affects mental or physical health. e.g. example hunched shoulders or a clenched jaw, stiff joints and problems with the spinal vertebrae		

Whiplash	Hyper flexion – extension injury to the neck as a result of a rear end collision	Pain and stiffness in the cervical spine with possible radiation of symptoms in the arms.	
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Scleroderma	A chronic autoimmune disease.	Hardening or sclerosis in the skin or other organs.	
Systemic Lupus Erythematosus (SLE)	An autoimmune disease of the connective tissues.	SLE most often harms the heart, joints, skin , lungs, blood vessels, liver, kidneys, and nervous system.	
Osteomalacia	Caused by deficiencies of phosphorus, calcium and vitamin D. Also known as Ricketts.	Abnormal softening of bones.	
Osteogenesis Imperfecta	A disorder of connective tissue.	Characterised by brittle bones that fracture easily.	
Psoriatic Arthritis	An immune system disorder	Characterised by joint pain and skin lesions.	
Paget's Disease	Increased osteoclastic and osteoblastic activity in bone cells.	Characterised by excessive over growth of the bone especially in the spine pelvis skull and femur.	
Rickets	Caused by a deficiency of vitamin D and the sunlight associated with impaired metabolism of calcium and phosphorus	Characterised by bowed legs knocked knees all other deformities of the skeleton.	
Spinal Stenosis	Narrowing of the spinal canal which compresses the spinal-cord and nerves	Characterised by pain on walking in the legs.	





Postural issues/faults




At times it is easy to observe some postural issues/faults. The diagram below shows characteristics of some of the most obvious postural issues.




Curvatures of the spine (side view)

Condition	Cause	Effect	Picture
Dowager's hump	Typically affecting older women (it CAN affect men, although not as often), when the spine begins to collapse with osteoporosis it causes people to hunch over, sometimes losing as much as a foot in height. Form of Kyphosis.	Abnormal curvature of the spine that manifests itself as a " hump " in the upper back.	
Round shoulders	Prolonged holding of bad postures such as at the computer or desk. Slouching is a common cause. Emotional factors and muscle holding patterns, For example, it is not uncommon for teenage girls to develop round shoulders temporarily as they pass through puberty. This is usually due to becoming self-conscious about breasts.	Stress on the spinal structures and adaptive changed the in muscles and soft tissues. The muscles and fascia (covering of muscles) tend to get shorter in the front of the chest. These include the pectoralis major and minor.	
Winged scapulae	Caused by serratus anterior paralysis. This is typically caused by damage to the long thoracic nerve.	The shoulder blade, or shoulder bone, protrudes from a person's back in an abnormal position. It is a rare condition with the potential to lead to limited functional activity in the upper extremity to which it is adjacent. It can affect a person's ability to lift, pull, and push weighty objects.	

<p>Midriff bulge</p>	<p>Sedentary lifestyle, pregnancy, age, little exercise, decreasing muscle mass, slower metabolism, high levels of cortisol (stress hormone)</p>	<p>Extra adipose tissue in the midriff area between waist and bust. It is common in women.</p>	
<p>Protruding abdomen</p>	<ul style="list-style-type: none"> • Pregnancy • Obesity • Umbilical hernia • Ovarian cyst • Post pregnancy • Constipation • Poor muscle tone • Lactose intolerance • Food allergies • IBS • Pancreatic disease • Gallbladder disease 	<p>Outward expansion beyond the normal girth of the stomach and waist.</p>	
<p>Hyper-extended knees</p>	<p>Falling badly or injury. It can damage ligaments, cartilage and other stabilizing structures in the knee. Sometimes it can be naturally occurring.</p>	<p>A hyperextended knee occurs when the knee is bent backward. Essentially, it extends past a normal range of motion in the straight position.</p>	
<p>Weight distribution</p>	<p>Incorrect distribution of weight in our feet can cause alignment issues which in turn cause pain and stiffness.</p>	<p>Alignment issues</p>	<p>See pictures in this section on poor alignment.</p>
<p>Poor muscle tone</p>	<p>Can happen in babies, small children and adults. Also known as 'hypotonia' which is the disruption of the signals between the muscles and nerves. It is a symptom rather than a condition and is caused by other underlying health conditions such as cerebral palsy, serious infections such as meningitis, muscle dystrophy and many more.</p>	<p>Difficulty using muscles for example, getting up from lying down, unusually high degree of flexibility in the hips, elbows, wrists, difficulty reaching/lifting objects.</p>	

<p>Kyphosis</p>	<p>Poor posture (postural kyphosis) – slouching, leaning back in chairs and carrying heavy bags which can stretch supporting muscles and ligaments</p> <p>Abnormally shaped vertebrae (Scheuermann’s kyphosis)</p> <p>Abnormal development of the spine in the womb (congenital kyphosis)</p> <p>Kyphosis can also develop as a result of a spinal injury.</p>	<p>The middle section of vertebrae (the thoracic vertebrae) is curved out of position</p>	
<p>Lordosis</p>	<p>Difference in the thickness between the front and back parts of the intervertebral disc. Imbalances in muscle strength and length are also a cause, such as weak hamstrings, or tight hip flexors (psoas).</p>	<p>Opposite of Kyphosis. A normal inward curvature of the lumbar and cervical regions of the spine.</p>	
<p>Scoliosis</p>	<p>Idiopathic scoliosis is the major type of scoliosis and the causes are unknown. A small number of cases are caused by other medical conditions, including:</p> <ul style="list-style-type: none"> • cerebral palsy • muscular dystrophy • Marfan syndrome <p>Age and changes in joint function and bone density can also be a cause.</p>	<p>Abnormal twisting and curvature of the spine.</p>	

Cervical Spondylitis	Degenerative arthritis between the cervical vertebra.	Characterised by pain and stiffness in the neck.	
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INTERRELATIONSHIP OF SKELETAL SYSTEM WITH OTHER BODY SYSTEMS

Muscular	Muscles always cross joints and thus relied on the framework of the skeleton for leverage and movement.
CVS	Erythrocytes (red blood cells) are produced in the bone marrow of long bones.
Nervous	Muscles require a nerve supply to contract which produces movement in the skeleton.
GIT (Digestive)	Breaks down foodstuffs and works with the circulatory system to transport nutrients to bone tissues.
Urinary	A hormone produced by the kidneys helps to stimulate the production of bone marrow in long bones.

EFFECTS OF MASSAGE ON JOINTS / SKELETAL SYSTEM

- Helps to mobilise joints by stimulating the formation of synovial fluid.
It does **NOT** improve / increase bone formation.
- Helps to ease painful sore joints
- Helps to keep joints more supple: increasing mobility

SYMPTOMS OF SKELETAL DISEASE

- Joint pain at rest and / or on movement
- Joint stiffness
- Swollen joints
- Red / hot joints
- Can be localised to one joint or be part of a widespread disease.