Functions of the Skeleton

1. Shape and Size. The bones play an important part in determining your height and build. Skeleton bone size can affect your performance in different sports.

2. Support. It gives the body support and enables us to stand and walk upright. The bones also help keep internal organs in place.

3. Protection. Many of our body parts and internal organs are protected by skeletons.

4. Movement. The bones work with muscles to produce movement.

5. Blood Cell Production. Red and white blood cells are made in the bones.

Bone Overview

The body is made up of 206 bones and can be divided into two distinct sections.

Axial skeleton - provides the main support for the body. Includes the skull, vertebral column and rib cage.

Appendicular skeleton - provides support for the appendages (external body parts). Includes limb bones and girdles which connect to the axial skeleton.

Cartilage

Bone is a replacement tissue - meaning it uses a model tissue to lay down its mineral matrix. During foetal development, a framework is laid done that determines where bones will form. As the child grows and develops, bone forms cartilaginous matrix. By foetus birth, most of the cartilage has been replaced.

Cartilage (cont)

Cartilage is softer than bone, less rigid and slightly elastic. Cartilage forms the temporary skeleton of the developing foetus but is gradually replaced almost entirely by bone. It is retained throughout life on the articular surfaces of most bone and as costal, nasal, laryngeal, tracheal and bronchial cartilage. Cartilage is made of Chondrocytes - active growing cell form and Chondroblast - mature form of cell occupying space in the matrix (lacunae).

Formation and Growth of Bones

Ossification is the process by which bone is formed from cartilage. The cartilage cells die off and are calcified to produced bone. Foetuses are initially formed from elastic tissue called cartilage (except for clavicle and parts of the cranium). As a baby grows, the cartilage becomes bone and hardens. This is part of the process of bone growth

There are two types of Osteogenic pathways

Formation and Growth of Bones (cont)

Intramembranous Ossification bone develops directly from mesenchyme (connective tissue found in developing embryo). Compact and spongy bone develops directly from sheets of mesenc-hymal (undifferentiated) connective tissue in the embryo (most flat face bones, cranial bones and clavicles) formed via this pathway. Intramembranous ossification begins during foetal development, and continues into adolescence. At birth the skull and clavicles not fully ossified nor are skull sutures closed allowing the skull and shoulders to deform during passage through the birth canal

Endochondral Ossification bone develops by replacing hyaline cartilage. Cartilage does not become bone, it is REPLACED by bone. By the time the foetal skeleton is fully formed, cartilage only remains at the joint surface and at the epiphyseal plate.

Types of Bone Tissue

There are two types of bone tissue.

Compact Bone Tissue Heavy, dense and strong. Ivory appearance. Forms shaft of long bones. Thickest in centre (bones weakest point).

Cancellous (Spongy Tissue) Honeycombed appearance. Strong and light. Found in places where extra strength is needed. Found mainly at the end of bones where they flare out to form joints.

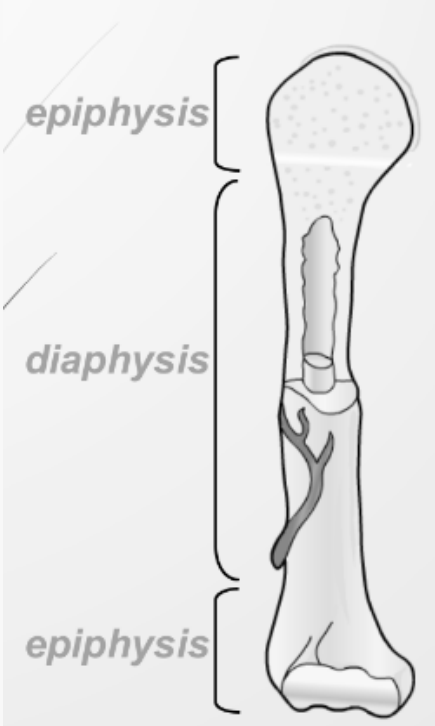
Long Bones

Long shaft containing yellow bone marrow. Responsible for a lot of movement and often act as levers. Long bones also contain red bone marrow for producing blood cells.

Examples: femur, humerus, tibia, fibula, metatarsals, meta carpals and phalanges

The end or the head of the bone is called the epiphysis. It is made up mainly of spongy bone which is full of tiny cavities. The shaft of the bone is called the diaphysis. It is hollow and made up of hard, dense compact bone. Periosteum is the membrane of the bones and is composed of connective tissue and osteoblasts.

Long Bone



Flat Bones

Flat bones perform a variety of functions including protection and muscle attachment.

They are made up of spongy bone between two layers of hard compact bone. They have a large surface area.

Examples: cranium, sternum

Short Bones

Very light and strong and are small and squat in shape.

They are composed of spongy bone with a thin layer of compact bone on the outside.

Examples: carpals, tarsals

Irregular Bones

Specifically shaped to perform a particular function.

Spongy bone on the inside, compact bone on the outside.

Examples: patella, vertebrae

Sesamoid Bones

A small bone that has developed in tendons around some joints of which the patella is the largest one.

Cell Terms

Blast Forming

Clast Destroying

Cyte Cell

Bone Composition

Hyaline Cartilage White, smooth, slipper surface found on the end of bones. Protects the end of bones, reduces friction in the joints.

Growth Plate Found where diaphysis and epiphysis meet. Growth plate is where bone growth in length occurs. When bone reaches maturity, growth plate fuses to form epiphyseal line.

Marrow Cavity Found in diaphysis, contains yellow bone marrow and consists of blood vessels, fat cells and immature white blood cells.

The Vertebral Column

The vertebral column is made up of 33 irregularly shaped bones. Between each vertebrae there is a pad of cartilage which allows movement and prevents the bones from grinding together. Cartilage is a type of connective tissue (softer than bone) that helps cushion joints and holds the bones together. The vertebrae protect the spinal cord (important nerve that runs through the centre of each vertebra). There are 5 sections of the vertebral column.

Cervical vertebrae (C1-C7) - Allows nodding and shaking of head

Thoracic vertebrae (T1-T12) - Protective shield for heart and lungs

Lumbar vertebrae (L1-L5) - Carries weight

Sacrum (5 fused bones) - Fuses to Pelvis and helps with weight distribution

Coccyx (4 fused bones) - Tailbone which acts as an attachment point for muscles

Important Bones

Zygomatic bone

Frontal bone

Orbit (eye socket)

Maxilla (upper jaw)

Genu

Mastoid process

Mandible

Atlas

Axis

Vertebrae groups: Cervical, thoracic, lumbar, sacrum, coccyx

Humerus

Radius

Ulna

Femur

Tibia

Fibula

Carpals, metacarpals

Tarsals, metatarsals

Phalanges

Talus

Calcaneus

Sternum: manubrium, xiphoid

Pelvic girdle: illium, ischium, pubis (joint: acetabulum)

Pectoral girdle: acromion process, clavicle, scapula

Joints

Joints are places where two or more bones meet. They are responsible for a huge range of motion and there are 3 types of joints.

Fixed or Immovable joints There are fewer than 10 in fixed joints in the body. They are also known as fibrous because the adjacent bones are held together by tough fibres. For example: skull and pelvis where several bones have fused together to form a rigid structure.

Cartilaginous Joints Bones are separated by cushion of cartilage. Joints between the vertebrae are cartilaginous. The bones can move a little bit but ligaments stop them from moving too far.

Synovial Joints 90% of joints in the body are synovial. They contain synovial fluid which is retained inside the synovial membrane. All moving parts are held together by ligaments. They are highly mobile joints.

Synovial Joints

Ball and Socket Joint: rounded end of one bone fits inside a cup-shaped ending on another bone. Allows movements in all directions and rotation. Are the most mobile joints in body. Examples: shoulder joint and hip joint.

Pivot Joint: have a ring of bone that fits over bone protrusion around which it can rotate. They only allow rotation. Examples: joint between atlas and axis, and joint between radius and ulna.

Synovial Joints (cont)

Saddle joint: ends of two bones fit together in a special way allowing forward, backward, left and right but no rotation. Example: only one, in thumbs.

Hinge joints: only allow forward and backward movement. Examples: knee and elbow joints.

Condyloid joints: oval-shaped bone which fits into a correspondingly shaped bone end. Allow forwards, backwards, left and right movement but no rotation. Examples: joints between phalanges and metacarpals.

Gliding joints: two flat faces of bone that slide over one another. Tiny bit of movement in all directions. Examples: joints between carpals and tarsals.

Joints and Old Age

Some people may develop arthritis, a disease that causes pain, stiffness and inflammation around joints.

Usually hereditary, but injured joints that have not healed properly can be more prone to arthiritis.

Diet and Health Issues

Minerals and calcium are important in your diet and specifically for bone strength. By the age of 35 bone tissue begins to be broken down more quickly than it is replaced. Osteoporosis occurs where bones become very brittle. To reduce the likelihood for this, weight-bearing exercises can help maintain bone density and strength.

Bone Growth Factors

Increase in length As long as epiphyseal plate remains present, bones can increase in length. Cartilage cells divide making the epiphyseal plate thicker. At the same time the side of the plate closest to the diaphysis is replaced by bone. Therefore the diaphysis becomes longer and the epiphysis remains the same size.

Increase in Diameter Osteoblasts beneath the periosteum deposit layers of bone. At the same time bone is being removed from inside the cavity. The net effect is an increase in bone diameter, but not bone thickness.

Factors Affecting Development Stress (gravity or function and bone deposits and withdrawal) , Hormones and Nutrition

Skeletal Terms

Process: bone prominence or prolongation

Crest: top of a ridge

Spine: a sharp process

Condyle: round, bulbous end of a bone usually for articulation

Tubercle: small rounded projection

Tuberosity: large rounded projection or roughened elevation

Trochanter: large blunt bony process

Facet: smooth flat rounded surface for articulation

Fissure: deep grove or fold

Foramen: natural hole

Foramina: a little hole

Skeletal Terms (cont)

Meatus: a short canal

Sinus: hole or cavity

Sulcus: a groove or depression between parts

Suture: joints of the skull, adjacent are united by fibrous membrane

Joint Movement

Flexion: angle between articulating bones is decreased. Occurs in the median plane about a horizontal axis. Muscles responsible for flexion are called flexors
Examples: running and jumping movements, Arm bend for serve in tennis.

Extension: angle of the joint is increased and extension occurs in the median plane about a horizontal axis. Muscles responsible for extension are known as extensors
Examples: running and jumping movements at hip and knee, throwing action in elbow.

Abduction: away from body midline
Examples: taking one leg away from middle to side step.

Adduction: towards body midline
Examples: adduction of shoulder backstroke.

Horizontal Flexion: moving arm forwards in horizontal plane (starting from abducted position)
Examples: throwing in sports, discus throw.

Horizontal Extension: returning arm to abducted position
Examples: throwing and racket sports movement at shoulder. Discus lean back.

Rotation: moving a limb in a circular motion in either direction
Examples: movement in racket sports.

Joint Movement (cont)

Circumduction: combination of flexion, extension, abduction and adduction
Examples: rolling wrist.

Hyper flexion: flexion of limb beyond normal limit
Examples: running and jumping movement at hip and knee

Hyper extension: angle is straightened beyond normal range
Examples: running and jumping movements at hip and knee

Pronation: palm face body
Examples: follow through tennis shot

Supination: palm forward
Examples: volley

Plantar flexion: extension of ankle, pointing of foot and toes
Examples: tippy toes

Dorsiflexion: flexion of foot in upwards direction
Examples: leaning back in chair and foot upwards, kick football up

Elevation: superior direction movement
Examples: shrug shoulders

Depression: inferior direction movement
Examples: push shoulders down

Protraction: movement forward (anteriorly)
Examples: push shoulders forwards

Retraction: movement backward (posteriorly)
Examples: push shoulders back and chest out

Inversion: sole of foot turned inwards toward imaginary midline

Eversion: sole of foot turned outwards from midline