• the bones •

The human skeleton consists of more than 200 individual bones, all fulfilling different tasks. In addition to cartilage tissue, our bodies are supported by bone tissue. Bone tissue provides protection for the soft parts underneath it and serves as a point of insertion for the muscles.

Another important role of bone is its metabolic activity (calcium household, blood formation in red bone marrow).

Cartilage tissue

Cartilage tissue is mainly to be found in the skeleton and the respiratory tracts. It is composed of cartilage cells (chondrocytes), located in small groups within a basic cartilaginous substance (extracellular matrix).

Depending on the type and quantity of the fibers, a difference is made between elastic cartilage, hyaline cartilage and fibrous cartilage. Cartilage is supplied with nutrients either through the joint fluid or via the perichondrium. Cartilage is able to withstand extreme pressure and is very resistant. Cartilage, primarily to be found in the skeleton and the respiratory tracts, is firm, yet reacts elastically to pressure and bending. This is made possible by the matrix of cartilage (intercellular substance) which, together with the cartilaginous cells, forms the cartilaginous tissue. Depending on the ratio between the matrix of cartilage and cartilaginous cells, a distinction is made between hyaline cartilage, fibrous cartilage and elastic cartilage.

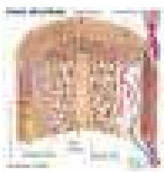
Cartilaginous cells are usually fairly round and to be found in groups within the matrix. The matrix of cartilage is 70% water, the rest consists of bundles of fibers with collagen, protein and elastin. Cartilage is supplied through the perichondrium or through synovia ("joint fluid"). As life goes on, the supply of nutrients diminishes, which can lead to wear and tear of the joints (arthrosis).

Hyaline cartilage is blueish in color and looks milky and glassy. It is especially to be found at the end of bones where joints are formed. It is also to be found in the ribs as costal cartilage and as laryngeal cartilage.

Fibrous cartilage consists of a network of numerous strong little fibers. It is highly tensile and may be found in menisci, intervertebral disks and in the pubic symphysis.

Elastic cartilage is yellowish in color. Its intercellular substance contains numerous elastic fibers which lend it its flexibility and elasticity. Elastic cartilage may be found in the region of the epiglottis and the auricle.

Bone Construction



In addition to the predominating bone tissue, lipogenic and hematogenic tissue may be found in the bone marrow region, tense connective tissue on the periosteum, cartilage in the growth zones and the epiphyses, and elastic connective tissue in the walls of the blood vessels. Bone is supplied by nerves.

Where an epiphysis (end of a joint) is missing, the bones are completely surrounded by the periosteum, consisting of two layers: one osteogenous (bone-forming) layer is located directly on top of the bone.

During the growth phase, it receives numerous osteogenous cells (osteoblasts), which then diminish in adults, not reappearing until a bone is broken and renewed cell formation is required. The outer layer of the periosteum consists of a network of high-tensile fibers, anchoring it directly to the bone. It serves to secure tendons, muscles and ligaments. The periosteum is supplied by blood vessels, lymph vessels and nerves. Bone - with the exception of dentin is the hardest substance within the human body.

Bone Formation

Bone formation (osteogenesis) can take place in one of two different ways. Either the bone develops directly from connective tissue, as for example with the flat skull bone or the bones forming the facial part of the skull, or the bone replaces cartilage at the ends of the long tubular bones following the growth phase and especially during it. Here a growth symphysis is located between the shaft and the end of the bone. Cartilage is reduced in both directions and replaced by bone tissue. At the same time new cartilage is formed, however, permitting lengthwise growth. Outwards growth takes place through the periosteum and throughout life.

the joints

Joints / Introduction

In order for physical movements to be carried out, the individual bones have to be able to move against each other and connected to each other. This is the function of the joints. According to the extent to which movement is facilitated, joints are distinguished between uni-axial, bi-axial and tri-axial to multi-axial joints. In addition to true joints (diarthroses), in which two bones always work within each other, whereby one of them is an articular head and the other an articular cavity, there are also false joints (synarthroses), such as fibrous or cartilaginous joints. In this case, the movements are more restricted; the sprung effect is predominant. Synovia reduces the friction between the articular surfaces. It is a fluid and is contained within an articular capsule, holding together the joint with its taut tissue.

A need for strength makes the bones rigid, but if the skeleton consisted of one solid bone, movement would be impossible. Nature has solved this problem by dividing the skeleton into many bones and creating joints where the bones intersect. Joints come in a variety of designs, each especially built for the limb it serves. Joints permit bodily movement and are held together by fibers called "ligaments". Joints are "oiled" continuously to prevent friction. Some joints, like those connecting the skull's series of bones, allow no movement. Others may permit only limited movement; the joints in the spine allow some movement in several directions. Most joints have a greater range of movement, and these are called "synovial" joints. The skeleton is made up of many kinds of movable joints. The bearing surface is made smooth by slippery cartilage to reduce friction. Larger joints are lubricated by "synovial" fluid. Connections called "synovial" joints are sturdy enough to hold the skeleton together while permitting a range of motions. The ends of these joints are coated with cartilages which reduce friction and cushion against jolts. Between the bones, in a narrow space, is the joint "cavity," which gives us freedom of movement. Ligaments then bind these bones to prevent dislocations and limit the joint's movements. The bones are held in position and controlled in movement by the ligaments. "Getting off on the wrong foot" or making a bad start is based on an ancient Roman superstition. They believed it to be bad luck to enter a house with the left foot first. The idea was so important to them that "footmen" were placed at the door to see that those entering would not misstep.

Joints connect the various bones within the skeleton, and can be divided into different categories.

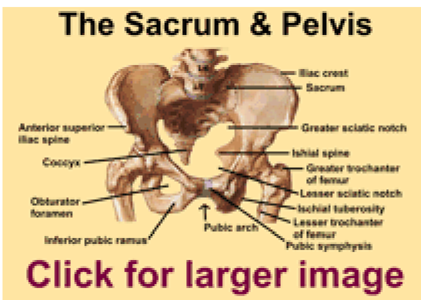
Fibrous joints connect two bones by means of elastic or collagen (high proportion of protein) connective tissue.

Fibrous joints form, for example, interossei membranes between the calf bone (fibula) and the shin bone (tibia).

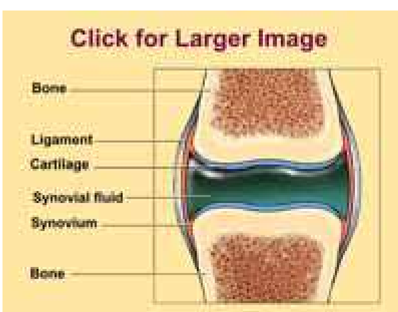
The sutures between the cranial bones of newborn babies are also fibrous joints. They contain connective tissue, which recedes completely by the end of the second year of life.

The way the teeth are fixed in the jaw is referred to as gomphosis. The tooth is held in place in the tooth socket by taut connective tissue.

Cartilaginous joints are permanent bone connections. A distinction is made between cartilaginous joints and fibrous cartilaginous joints. A cartilaginous joint is composed of hyaline cartilage. Examples are the connection between the first, sixth and seventh ribs (costa) and the breastbone (sternum). A fibrous cartilaginous joint is composed of fibrous cartilage and connective tissue. Examples of this are the pubic symphysis (shown on the right and below) and the intervertebral disks. Joints are lubricated by "synovial" fluid. Connections called "synovial" joints are sturdy enough to hold the skeleton together and at the same time permit a range of motions. The ends of these joints are coated with cartilages which reduce friction and cushion against jolts.



Synovial joints permit a large degree of movement. For this reason they are also termed freely mobile joints. This type of joint consists of at least two articular bodies. They are covered with cartilage.



This way the two articular bodies - the articular cavity and the articular head can glide against or over each other. The articular capsule is joined directly to the articular surfaces. It consists of two layers containing nervous fibers and blood vessels and is reinforced on the outside by strong lateral ligaments. In addition, synovia is constantly produced by the inner skin of the articular capsule, making it easier for the articular bodies to glide.

Joint Shapes

The true joints can be divided up into different shapes according to their degrees of movement:

The ball-and-socket joint has the greatest mobility. It comprises a ball-shaped articular head which fits into a hollow, round articular cavity.

The articular head can not only turn in any direction, but also around its own axis, insofar as it is not impeded by fixed ligaments.

One example of a ball-and-socket joint is the shoulder joint. It facilitates not only up and down movements of the arm, but also sideways stretching out from the body, as well as circular movements.

The hip joint is another example of a ball-and-socket joint. Here the degree of movement is somewhat restricted, however, because the articular head is enclosed by the articular cavity by up to 2/3. This protects the hip from dislocation.

The saddle joint consists of two articular bodies which are concavely curved along one axis and convexly curved along the other.

One example of this is the carpometacarpal joint in the thumb (shown to the left).

Attached to a saddle-shaped articular surface on the trapezium (os trapezium) is the correspondingly shaped basis of the first metacarpal bone. The thumb can be bent and stretched around one axis, and "twiddled" around the other.

This joint facilitates complicated movements in the hand region (grip hand).

Level joints have two level articular surfaces, for example the interverte- bral joints within the cervical spine. The shape of this joint, falling flatly backwards, permits bowing movements, both forwards and backwards.

The rotational joints include the pivot and cone joints. They consist of a concave and a cylindrical articular body, whereby the articular axis runs through the longitudinal axis of the cylindrical body.

An example of a cone joint is the upper spoke bone ulnar joint; an example of a pivot joint is the lower spoke bone ulnar joint.

Hinged joints only permit movement in one direction.

The joint consists of an articular head with a cylindrical appearance and an articular cavity with the appearance of a hollow cylinder, largely enclosing the articular head. One example of a hinged joint is the upper arm elbow joint.

Ellipsoid joints permit movements around two mutually perpendicular axes.

In this case, the articular head is shaped like an egg and the articular cavity has the corresponding hollow form. The upper wrist is a particualrly obvious example of this. One plane permits stretching and bending movements, the other plane movements towards the thumb or little finger.

• the ligaments •

What is it?

A ligament is a tough band of white, fibrous, slightly elastic tissue.This is an essential part of the skeletal joints; binding the bone ends together to prevent dislocation and excessive movement that might cause breakage. Ligaments also support many internal organs; including the uterus, the bladder, the liver, and the diaphragm and helps in shaping and supporting the breasts. Ligaments, especially those in the ankle joint and knee, are sometimes damaged by injury. A "torn" ligament usually results from twisting stress when the knee is turned while weight is on that particular leg. (Read more about anterior cruciate ligament injuries {knee_lig_injuries} here). Minor sprains are treated with ice, bandages, and Chiropractic therapy, but if the ligament is torn, the joint may be placed in a plaster cast to allow time to heal or it may require surgical repairs. If a ligament is made up of several thick bands of fibrous branches, it is called a "collateral ligament. " The word "ligament" comes from the Latin word, "ligamentum," meaning a band or tie.

In descriptive medical anatomy, the term ligament is used for special sets of collagen fibres associated with joints. There are two types of these sets: capsular and noncapsular.

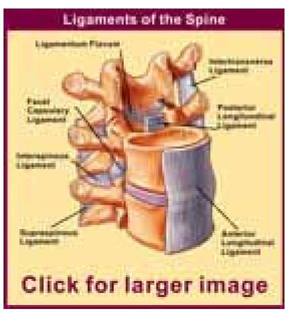
Capsular ligaments are simply thickenings of the fibrous capsule itself, taking the form of either elongated bands or triangles the fibres of which radiate from a small area of one articulating bone to a line upon its mating fellow. The iliofemoral ligament of the hip joint is an example of a triangular ligament. Capsular ligaments are found on the outer surface of the capsule. There is one exception to this rule: ligaments of the shoulder joint (glenohumeral ligaments) are found on the inner surface.

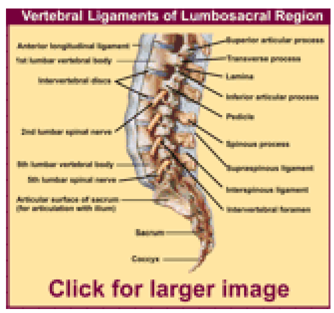
Noncapsular ligaments are free from the capsule and are of two kinds, internal and external.

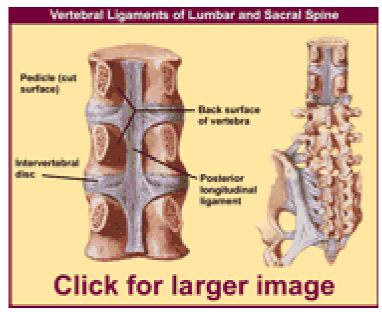
The internal type is found in the knee, wrist, and foot. In the knee there are two, both arising from the upper surface of the tibia; each passes to one of the two femoral condyles and lies within the joint cavity surrounded by synovial membrane. They are called cruciate ligaments because they cross each other X-wise. At the wrist most of the articulations of the carpal bones share a common joint cavity, and neighbouring bones are connected sideways by short internal ligaments. The same is true of the tarsal bones that lie in front of the talus and calcaneus.

The external, noncapsular ligaments are of two kinds, proximate and remote. The proximate ligaments pass over at least two joints and are near the capsules of these joints. They are found only on the outer side of the lower limb. Examples are the outer (fibular) ligament of the knee, which passes from the femur to the upper part of the fibula over both the knee and tibiofibular joints, and the middle part of the outer ligament of the ankle joint, which passes from the lowest part of the fibula to the heel bone. These two ligaments, particularly that passing over the ankle, are especially liable to damage (sprain).

The remote ligaments are so called because they are far from, rather than close to, the joint capsule. A notable example is that of the ligaments that pass between the back parts (spines and laminae) of neighbouring vertebrae in the cervical, thoracic, and lumbar parts of the spinal column. (See figures below).







These are the chief ligaments of the pairs of synovial joints between the vertebrae of these regions. Unlike most ligaments they contain a high proportion of elastic fibres that assist the spinal column to return to its normal shape after it has been bent forward or sideways.

Contrary to the opinion of earlier anatomists, ligaments are not normally responsible for holding joint surfaces together. This is because a set of collagen fibres, like a string, can exert a reactive force only if stretched and tightened by some tensile stress. Normally the bones at a joint are pressed together (when at rest) by the action of muscles or gravity. An individual ligament can stop a movement that tightens it. Such a movement will loosen the ligaments that would be tightened by the opposite movement. The one exception to this case is the movement that brings a joint into the close-packed position. This movement is brought about by a combination of a swing with a spin of the moving bone. Experiment shows that the combination of movement screws the articular surfaces firmly together so that they cannot be separated by traction and that the capsule and most of the ligaments are in simultaneous maximal tautness.

• the muscles •

Muscles/Introduction

The muscles are the active part of the apparatus of locomotion. Their task is to move the body. The muscles comprise 40% of the body's weight. The body has 300 individual muscles (musculi) in different shapes and sizes.

The basis of the muscles are muscle cells, capable of contracting longitudinally in response to nervous stimulation. The muscle cells contain small contractile strands of protein (so-called myofibrils). They contract when stimulated, returning to their original state as soon as the stimulation ceases. Muscle fibers and muscle cells are distinguished according to their construction:

- Striped muscle
- Smooth muscles
- Cardiac muscle (myocardium)

The smooth muscles consist of smooth muscle fibers. Their myofibrils (muscle fibers) run through the muscle fibers longitudinally and are of equal length. Consequently, the muscle fibers look smooth and not striated. These cells are 40-500µm long and 4-20µm thick.

The smooth muscles carry out the involuntary movements of the inner organs, e.g. the (peristaltic) bowel movement. The nerves are supplied exclusively by the vegetative (autonomous) nervous system.

The striped muscles are composed of different kinds of tissue: most of them striped muscle fibers. They make up all the skeletal muscles, facilitating our voluntary movements and reflexes. These voluntary movements are driven by stimuli within the cerebral cortex (cortex cerebri) and reach the muscles via nerve paths in the spinal cord (medulla spinalis) and myokinetic nerves. In contrast, involuntary movements stem from myokinetic centers in the brain stem (truncus cerebri) and take place automatically through a voluntary impulse within the cerebral cortex.

The muscle fibers of the striped muscles are multinuclear, cylindrical cells, which can be up to 12 cm (4,68 in) long and 100µm thick. Their striations are due to myofibrils within the cells. The cells and their nuclei are directly under the surface, with their longitudinal axes running in the same direction as the fibers. A microscopic view reveals alternating double and single light-refracting sections. Here it is clear that the myofibrils are made up of thick and thin myosin filaments. Thicker filaments are categorized as double-refracting, thinner filaments as single-refracting sections.

Muscle Function

On entering the muscle, the myokinetic nerves split up into individual fibers and make contact with every single muscle cell. An electric impulse from the brain (cerebrum) runs down the nerve to the motor end-plate (synapse), forming the transition between nerve and muscle. This stimulus is transferred from the nerve to the muscle by acetylcholine, triggering the contracting of the muscle.

This process occurs as follows: In each muscle fiber (filament) there are two different proteins (actin & myosin). They are connected by transverse bridges.

At rest, the pattern is loosely meshed, with few bridges. If the filaments move across each other, the muscle shortens. Myosin and actin filaments join up, form additional transverse bridges and create a much more closely meshed pattern.

Once enough muscle fibers have contracted, the entire muscle shortens and the bone (os) is moved. The strength of the muscle contraction depends on the strength and frequency of the stimulation which reaches it. If the link between nerve and muscle is interrupted, the muscle movement is out of order or paralysed.

Muscular activity generates lactic acid (organic hydroxy acid which forms when carbohydrates divide) within the muscle. If too much acid is generated, the muscle becomes harder, its contractions and therefore its movements become smaller, the muscles ache.

Some muscles are always contracted at any point in time. They are in a state of tension (tonus), giving the body posture. The assumption of a particular posture (e.g. standing or lying down) is also a result of muscular tension, a force which can only be maintained through a high consumption of energy. This force without movement is also known as isometric contraction. When the body moves, the muscular tension must be increased and the muscle shortened (isotonic contraction). Muscles working in unison during a movement are termed synergists and the muscles working against them are called antagonists.

Depending on the movement, the combination of synergists and antagonists changes. When the hand (manus) is flexed, for example, several muscles work together as synergists, yet when the lower arm (antebrachium) is moved outwards, the same muscles function as antagonists. Synergists and antagonists must cooperate correctly for specific movements to be carried out.

Our natural movements usually involve not only the activity of a few muscles, but the use of numerous muscles one after the other. The muscles may be divided up according to their main movements:

- Flexors and extensors
- Adductors and abductors
- External rotators (exorotators) and internal rotators (endorotators)

The origin (origio) and insertion (sertio) of the striped muscles are constructed from high-tensile connective tissue. Loose connective tissue (endomysium) may be found between the individual muscle fibers, facilitating their movements during contractions.

Stronger connective tissue (perimysium) holds several bundles (fasciae) of muscle fibers together, connecting them to each other. They can be recognized as fleshy fibers with the naked eye.

The myocardium reveals cell features of the striped and the smooth muscles. It consists of muscle fibers which form a cell bond without fixed borders between the cells. Cardiacmuscle (myocardial) fibers are 20-30µm thick. The myofibrils of one fiber run into the other fibers in a marked longitudinal direction, giving the myocardial fiber a clear longitudinal striation. The myofibrils of the cardiac muscles are striped, albeit more finely than those of the skeletal muscles. The myocardium is controlled by the 10th cranial nerve (nervus cranialis).

The myocardium has a high energy requirement, supplied by numerous blood vessels. Larger vessels run through the strong connective tissue, whereas capillaries branch off to form a network in the epimysium (moving layer). Each muscle contraction is driven by a myokinetic nerve, leading to the motor end-plate (synapse). This is the point of contact between nerve fiber and muscle fibers, in which stimuli (from nerves within the spinal cord or the brain) are transferred. Anything from one muscle fiber up to 100 (through branching) can be supplied simultaneously.

Auxilliary Organs of the Muscles

The auxiliary organs of the skeletal muscles include tendons (tendo), fasciae, tendon sheaths (vagina tendinis), synovial sacs (bursa synovialis), sesamoid bones (os sesamoideum) and tendinous cartilage.

Muscular traction is transferred to the bones by tendons. At the muscle origin (origo) and the muscle insertion (insertio), they run into the collagen fibers of the bone.

Tendons are composed of highly tensile collagen fiber bundles, holding the ends of the muscle fiber bundles together in a fixed structure in the manner of a rope. Short tendons form the insertion of a muscle, as can be seen in the large pectoral muscle (musculus pectoralis major), for example. In contrast, the tendons within the hand and foot muscles, for example, are very narrow and long. Surface tendons (aponeuroses) are to be found in oblique abdominal muscles.

The tendons can be additionally divided up into pressure (push) and traction (pull) tendons.

Pressure tendons change their course of direction by running around bones, and are strained by pressure on the side facing the bone. One example of this is the insertion tendon of the long calf muscle (musculus peronaeus longus). It runs around the side of the cuboid bone and then inserts on the underneath side of the foot.

Traction tendons run in the main direction of the muscle and are only strained by traction. Fasciae are connective tissue covers surrounding individual muscles or muscle groups. This enables several muscles to glide over each other without any friction.

Tendon sheaths are lubricated covers improving the gliding abilities of tendons. A tendon sheath is constructed similarly to an articular capsule.

The outer layer (stratum fibro- sum) consists of connective tissue, the inner layer (stratum synoviale) excretes a kind of synovia to improve lubrication.

Synovial sacs (bursae syno- viales) have the task of protecting muscles which run directly around bones.

Sesamoid bones can be found wherever tendons are subjected to particular pressure. They are embedded at the deflection point of a tendon. There they form a synovial joint with the bone below, in order to reduce friction. The largest sesamoid bone is the knee cap (patella). Sesamoid cartilage serves to cartilage over a tendon without bone deposits. The individual muscles are separated by adipoids (corpora adiposa). These fatty bodies also serve to improve lubrication.

• the skeleton •

What is it?

The human skeleton, like that of other vertebrates, consists of three subdivisions, each with origins distinct from the others and each presenting certain individual features. These are (1) the axial, comprising the vertebral column—the spine—and much of the skull; (2) the visceral, comprising the lower jaw, some elements of the upper jaw, and the branchial arches, including the hyoid bone, and (3) the appendicular, to which the hip and shoulder girdles and the bones and cartilages of the limbs belong.

1) The Axial Skeleton

The axial skeleton consists of the skull, vertebral column, and rib cage. The appendicular skeleton contains the bones of the appendages (limbs, wings, or flippers/fins), and the pectoral and pelvic girdles.

The vertebral column has 33 individual vertebrae separated from each other by a cartilage disk. These disks allow a certain flexibility to the spinal column, although the disks deteriorate with age, producing back pain. The sternum is connected to all the ribs except the lower pair. Cartilage allows for the flexibility of the rib cage during breathing.

2) The Visceral Skeleton

The human skull, or cranium, has a number of individual bones tightly fitted together at immovable joints. At birth many of these joints are not completely sutured together as bone, leading to a number of "soft spots" or fontanels, which do not completely join until the age of 14-18 months.

3) The Appendicular Skeleton

The arms and legs are part of the appendicular skeleton. The upper bones of the limbs are single: humerus (arm) and femur (leg). Below a joint (elbow or knee), both limbs have a pair of bones (radius and ulna in the arms; tibia and fibula in legs) that connect to another joint (wrist or ankle). The carpals makeup the wrist joint; the tarsals are in the ankle joint. Each hand or foot ends in 5 digits (fingers or toes) composed of metacarpals (hands) or metatarsals (feet).

Limbs are connected to the rest of the skeleton by collections of bones known as girdles. The pectoral girdle consists of the clavicle (collar bone) and scapula (shoulder blade). The humerus is joined to the pectoral girdle at a joint and is held in place by muscles and ligaments. A dislocated shoulder occurs when the end of the humerus slips out of the socket of the scapula, stretching ligaments and muscles. The pelvic girdle consists of two hipbones that form a hollow cavity, the pelvis. The vertebral column attaches to the top of the pelvis; the femur of each leg attaches to the bottom.

• the spine •

What is it?

The spine, also know as the spinal column, the vertebral column and the backbone, is often used to describe the most important part of an entity, and for good reason: it's this S-curved structure around which our ability to walk, run, and sleep is hinged. Our arms, legs, chest, and head all attach to the spine. And the spine affects and is affected by every movement we make. No back problem can be isolated from how the rest of our body functions. Because of this interdependence, only by understanding the whole body and how movements affect the spine can we approach back problems.

Spinal anatomy is truly unique in its form and function. It is designed to be incredibly strong, protecting the highly sensitive nerve roots, yet highly flexible, providing for mobility on many different planes.

However, many different structures in the spine are capable of producing back pain, including:

- The large nerve roots that go to the legs and arms may be irritated
- The smaller nerves that innervate the spine may be irritated

- The large paired back muscles (erector spinae) may be strained
- The bones, ligaments or joints themselves may be injured

Spine Basics

In animals, body weight is distributed evenly on all four legs; dinosaurs or dog, the spine lies in a horizontal position. Animals may be afflicted with their own sets of problems, but back pain usually isn't among them. In human beings, however, the spine is held in a vertical position. Walking upright may have freed our ancestors to engage in myriad civilized activities, from sipping tea to carrying a bag of groceries, but it literally created a pain in our backs. Walking on two legs places an enormous strain on our spines.

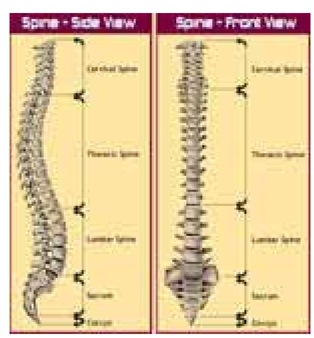
The back is not made up of a single bone but is an engineering masterpiece, composed of donut-shaped bones called vertebrae. These irregular, spool-shaped structures are stacked one on top of the other. Each vertebra is separated by a ring of shock-absorbing cartilage. These disks make spinal movement possible.

The spine extends from the base of the skull to the tailbone. The spine or back is not made up of a single bone but is an engineering masterpiece, composed of donut-shaped bones called vertebrae. These irregular, spool-shaped structures are stacked one on top of the other. Each vertebra is separated by a ring of shock-absorbing cartilage called disks. These disks make spinal movement possible.

Your spine is divided into five sections: the cervical, the thoracic, the lumbar, the sacrum, and the coccyx. There are 7 cervical, 12 thoracic, 5 lumbar, 5 fused sacral, and 3 to 5 fused vertebrae (together called the coccyx). The images below show the basic spinal structure. Each unit of the spine will be explained in further detail.

Term	# of Vertebrae	Body Area	Abbreviation
Cervical	7	Neck	C1 – C7
Thoracic	12	Chest	T1 – T12
Lumbar	5 or 6	Low Back	L1 – L5
Sacrum	5 (fused)	Pelvis	S1 – S5
Coccyx	3 - 5	Tailbone	None

Front & Side Views of the Spine



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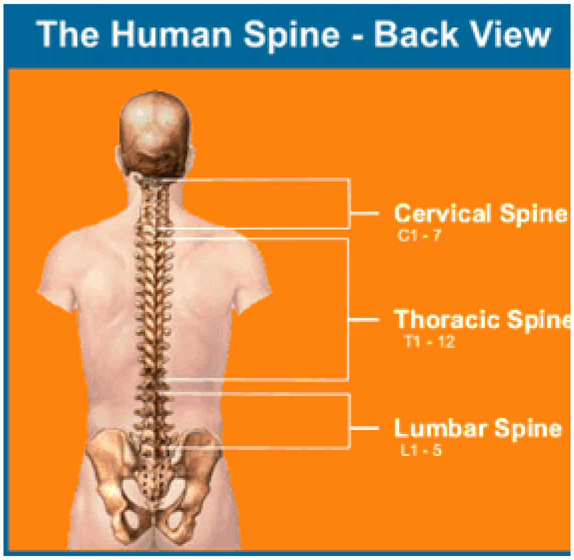
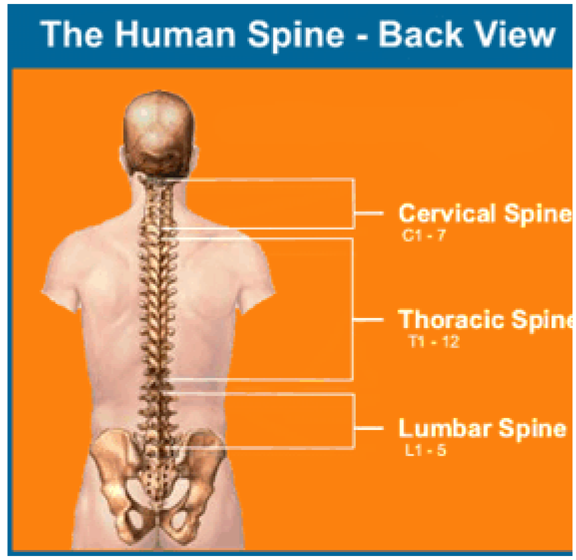
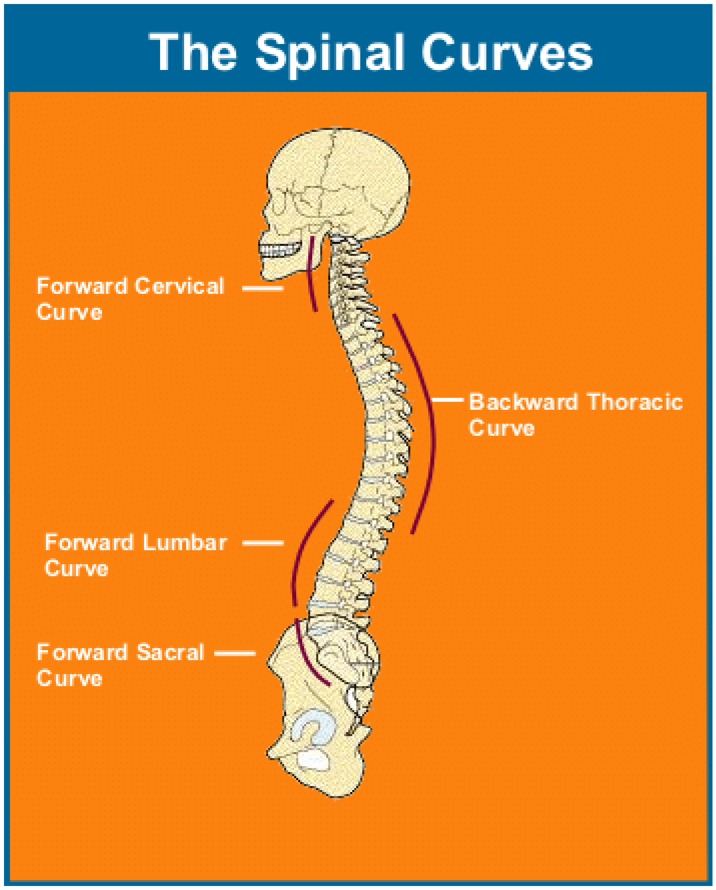




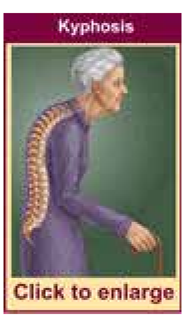
The vertebral column is characterized by a variable number of curves. These curves are: (1) a sacral curve, in which the sacrum curves backward and helps support the abdominal organs, (2) a forward cervical curve, which develops soon after birth as the head is raised, and (3) a lumbar curve, which develops as the child sits and walks. (see figure below).

Natural curves are important. Without these curves the spine would not have the strength and resilience to act as a shock absorber during movement. The back's curves are designed to absorb shock and to facilitate the full range of motion throughout the spinal column. The natural curves act as a coiled spring to absorb force or jarring during activity. Jogging or jumping rope would be impossible without these curves. The yielding curves are the pillars of strength, resilience, and flexibility in the spine. Nonetheless, our back's flexibility is not without its own set of problems.

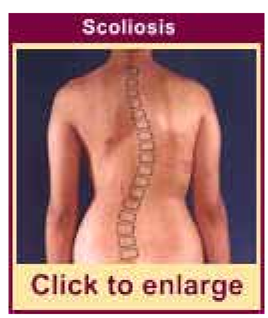


Type of Spinal Curves	Curve Description
Kyphosis or Kyphotic Curve	Concave anteriorly and convex posteriorly
Lordosis or Lordotic Curve	Convex anteriorly and concave posteriorly
Curvature	**Normal Curvature**
Cervical Lordosis	20 to 40 degrees
Thoracic Kyphosis	20 to 40 degrees
Lumbar Lordosis	40 to 60 degrees
Sacral Kyphosis	Sacrum fused in a kyphotic curve

Pathologic curvatures of the human spinal column are common. These conditions may be caused by weak ligaments, by poor posture habits, by disease or congenital abnormalities of the spinal column, by injury, or by spasm of the back muscles.



One well-known spinal curvature is hunchback, a humped condition of the thoracic or dorsal spine resulting from an extreme curvature of the spine. This curvature may be either a kyphosis, which is an accentuation of the normal posterior curvature, or a combination of kyphosis and extreme lateral



curvature (scoliosis), which is known as kyphoscoliosis. Scoliosis alone rarely creates a hunchback appearance. Kyphosis may be mild or severe. Although most cases of kyphosis are congenital, the condition may result from spinal injury. (Before the development of effective antitubercular drugs, a hunchback condition was sometimes caused by Pott's disease, a form of tuberculosis affecting the vertebrae.) Collapse may occur in elderly people, particularly women, whose bones may become soft and brittle, causing a dorsal kyphosis. When curvature results from collapsed vertebrae, the person loses height along with developing the curvature. As a result of the spinal deformity in hunchback, the ribs become contorted, compressing or displacing the lungs and other structures within the chest cavity and thrusting the collarbone and shoulder blades into distorted positions. Deformations take place in the hips and other parts of the body in its effort to maintain balance.

Treatment for a hunchback condition is varied. A mild kyphosis can often be corrected with plaster casts and braces if diagnosed before the skeletal frame has completed its growth. Chiropractic manipulation can improve and control the musculoskeletal symptoms such as pain, achiness and loss of function as a result of the deformity. Congenital deformities cannot be cured. The malformation of the vertebrae are embryological in origin; only a certain amount of the deformity can be minimized by surgery and local manipulation. Hunchback caused by spinal disease is also only slightly amenable to surgery and local treatment. Traction, pads, and plaster-jacket supports are used in manipulative treatments, and electrical stimulation is also being studied. Scoliosis is sometimes addressed surgically by insertion of a metal rod along the spine.

The spine may also be affected by herniated or ruptured pulposus, a condition in which the posterior longitudinal ligament, lying on the forward side of the neural canal, gives way or allows passage of some of the substance of the cartilage between the vertebrae into the canal. This ruptured disk material presses on the nerve roots or the spinal cord, causing great pain, a condition known as slipped disk.