

1-1 Introduction:

Humans are vertebrates, animals having a vertebral column or backbone. They rely on a sturdy internal frame that is centered on a prominent spine. The human skeletal system consists of bones, cartilage, ligaments and tendons and accounts for about 20 percent of the body weight. The living bones in our bodies use oxygen and give off waste products in metabolism. They contain active tissues that consume nutrients, require a blood supply and change shape or remodel in response to variations in mechanical stress. Bones provide a rigid framework, known as the skeleton that support and protect the soft organs of the body. The skeleton supports the body against the pull of gravity. The large bones of the lower limbs support the trunk when standing. The skeleton also protects the soft body parts. The fused bones of the cranium surround the brain to make it less vulnerable to injury. Vertebrae surround and protect the spinal cord and bones of the rib cage help protect the heart and lungs of the thorax. Bones are rigid [organs](#) that constitute part of the [endoskeleton](#) of [vertebrates](#). They support, and protect the various organs of the body, produce [red](#) and [white blood cells](#) and store [minerals](#). Bone tissue is a type of dense [connective tissue](#). Bones come in a variety of shapes and have a complex internal and external [structure](#), are lightweight yet strong and hard, and serve multiple [functions](#). One of the types of tissue that makes up bone is the mineralized [osseous tissue](#), also called bone tissue that gives it rigidity and a [honeycomb-like](#) three-dimensional internal structure. Other types of tissue found in bones include [marrow](#), [endosteum](#) and [periosteum](#), [nerves](#), [blood vessels](#) and [cartilage](#). At birth, there are over 270 bones in an infant human's body, but many of these fuse together as the child grows, leaving a total of 206 separate bones in an adult. The largest bone in the human body is the [femur](#).

Bones work together with muscles as simple mechanical lever systems to produce body movement. Bones contain more [calcium](#) than any other organ. The intercellular matrix of bone contains large amounts of calcium salts, the most important being calcium phosphate. When blood calcium levels decrease below normal, calcium is released from the bones so that there will be an adequate supply for metabolic needs. When blood calcium levels are increased, the excess calcium is stored in the bone matrix. The dynamic process of releasing and storing calcium goes on almost continuously. Hematopoiesis, the formation of blood cells, mostly takes place in the red marrow of the bones. In infants, red marrow is found in the bone cavities. With age, it is largely replaced by yellow marrow for fat storage. In adults, red marrow is limited to the spongy bone in the skull, ribs, sternum, clavicles, vertebrae and pelvis. Red marrow functions in the formation of red blood cells, white blood cells and blood platelets.

Congenital malformations have defied fully satisfactory solution till this day, even in the present atomic age. The incidence of malformations in the new born differ from country | country and one region to another within the same country, The incidence of total malformations the various systems of the body in live born range from 1.7 to 3%.

1-2 Research problems:

Skeletal deformities in pediatric have different types and involve different part of the skeletal the study want to collect and explain these types of deformities and he evaluation in conventional radiology.

1-3 Objectives:

1-3-1 The general objective

The goal of this study is evaluate the types of skeletal deformities in pediatrics according to conventional radiology

1-3-2 The specific objective:

To assess the accuracy of conventional radiology in detecting the bone disease.

To assess the increase and decrease in one density, length, shape.

To record the most common site and type of skeletal deformity and technique used.

1-4 Thesis scope:

Chapter One: Will include an introduction, the objectives of the research, methodology, machine used.

Chapter Two: Literature review will consist the following: back ground and previous study

Chapter Three: Material and methods

Chapter Four: The Results

Chapter Five: Discussion, Conclusion and Recommendations

Reference

Appendices

Chapter two

Back ground

2-1 The skeletal system

The Skeletal System serves many important functions; it provides the shape and form for our bodies in addition to supporting, protecting, allowing bodily movement, producing blood for the body, and storing minerals. The term skeleton comes from a Greek word meaning "dried up". {William W.Reynolds et al.1977.american society of ichthyologists & herpetologists. Wikipedia.org)

The human skeleton consists of both fused and individual [bones](#) supported and supplemented by [ligaments](#), [tendons](#), [muscles](#) and [cartilage](#). It serves as a scaffold which supports organs, anchors muscles, and protects organs such as the [brain](#), [lungs](#) and heart, the biggest bone in the body is the [femur](#) in the thigh and the smallest is the [stapes](#) bone in the [middle ear](#). In an adult, the skeleton comprises around 30–40% of the total body weight, and half of this weight is water.

{William W.Reynolds et al.1977.american society of ichthyologists & herpetologists. Wikipedia.org)

Fused bones include those of the [pelvis](#) and the [cranium](#). Not all bones are interconnected directly: there are three bones in each [middle ear](#) called the [ossicles](#) that articulate only with each other. The [hyoid bone](#), which is located in the neck and serves as the point of attachment for the [tongue](#), does not articulate with any other bones in the body, being supported by muscles and ligaments. {William W.Reynolds et al.1977.american society of ichthyologists & herpetologists. Wikipedia.org)

Development

Early in gestation, a fetus has a cartilaginous skeleton from which the long bones and most other bones gradually form throughout the remaining gestation period and for years after birth in a process called endochondral ossification. The flat bones of the skull and the clavicles are formed from connective tissue in a process known as intramembranous ossification, and ossification of the mandible occurs in the fibrous membrane covering the outer surfaces of Meckel's cartilages. At birth, a newborn baby has over 300 bones, whereas on average an adult human has 206 bones^[2] (these numbers can vary slightly from individual to individual). The difference comes from a number of small bones that fuse together during growth, such as the sacrum and coccyx of the vertebral column. ("Skeleton – Bone growth". BBC. Retrieved 19 July 2010.wikipedia.org)

Organization:

There are over 206 bones in the adult human skeleton, a number which varies between individuals and with age – newborn babies have over 270 bones some of which fuse together into a longitudinal axis, the [axial skeleton](#), to which the [appendicular skeleton](#) is attached. (Miller, Larry, 2007"we re born with 270 bones. wikipedia.org).

2-1-1 Axial skeleton

The axial skeleton (80 bones) is formed by the [vertebral column](#) (26), the [rib cage](#) (12 pairs of [ribs](#) and the [sternum](#)), and the [skull](#) (22 bones and 7 associated bones). The axial skeleton transmits the weight from the head, the trunk, and the upper extremities down to the lower extremities at the [hip joints](#), and is therefore responsible for the upright position of the human body. Most of the body weight is

located in back of the spinal column which therefore have the [erectors spinae](#) muscles and a large amount of [ligaments](#) attached to it resulting in the curved shape of the spine. The 366 skeletal muscles acting on the axial skeleton position the spine, allowing for big movements in the thoracic cage for [breathing](#), and the head. Conclusive research cited by the American Society for Bone Mineral Research (ASBMR) demonstrates that weight-bearing exercise stimulates bone growth. Only the parts of the skeleton that are directly affected by the exercise will benefit. Non weight-bearing activity, including swimming and cycling, has no effect on bone growth. [[Tözeren, Aydın \(2000\). Human Body Dynamics.wikipedia.org](#)]

2-1-2 Appendicular skeleton

The appendicular skeleton (126 bones) is formed by the pectoral girdles (4), the upper limbs (60), the pelvic girdle (2), and the lower limbs (60). Their functions are to make locomotion possible and to protect the major organs of locomotion, digestion, excretion, and reproduction.

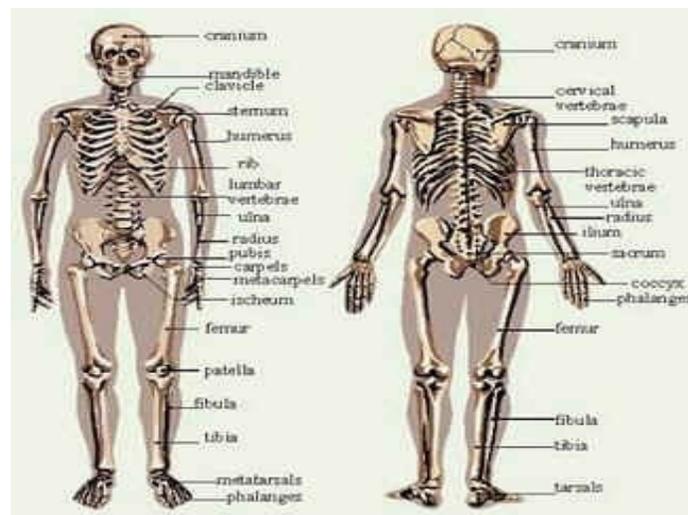


Fig 2-1: The human skeleton

<http://en.wikipedia.org/wiki/skeleton>

2-1-3 Functions of the skeletal system

The skeleton serves six major functions.

2-1-3-1 Support

The skeleton provides the framework which supports the body and maintains its shape. The pelvis and associated ligaments and muscles provide a floor for the pelvic structures. Without the [ribs](#), [costal cartilages](#), the [intercostal muscles](#) and the [heart](#) would collapse. [[Tözeren, Aydın \(2000\). Human Body Dynamics.wikipedia.org](#)].

2-1-3-2 Movement

The joints between bones permit movement, some allowing a wider range of movement than others, e.g. the ball and socket joint allows a greater range of movement than the pivot joint at the neck. Movement is powered by [skeletal muscles](#), which are attached to the skeleton at various sites on bones. Muscles, bones, and joints provide the principal mechanics for movement, all coordinated by the nervous system. [[Tözeren, Aydın \(2000\). Human Body Dynamics.wikipedia.org](#)].

2-1-3-3 Protection

The skeleton protects many vital [organs](#):

- The [skull](#) protects the [brain](#), the [eyes](#), and the [middle](#) and [inner ears](#).
- The vertebra protects the [spinal cord](#).
- The [rib cage](#), spine, and [sternum](#) protect the [lungs](#), [heart](#) and major [blood vessels](#).

- The [clavicle](#) and [scapula](#) protect the [shoulder](#).
- The [ilium](#) and spine protect the digestive and urogenital systems and the [hip](#).
- The [patella](#) and the [ulna](#) protect the [knee](#) and the [elbow](#) respectively.
- The [carpals](#) and [tarsals](#) protect the [wrist](#) and [ankle](#) respectively.

2-1-3-4 Blood cell production

The skeleton is the site of [haematopoiesis](#), which takes place in red [bone marrow](#).

2-1-3-5 Storage

Bone matrix can store [calcium](#) and is involved in [calcium metabolism](#), and [bone marrow](#) can store [iron](#) in [ferritin](#) and is involved in [iron metabolism](#). However, bones are not entirely made of calcium, but a mixture of [chondroitin sulfate](#) and [hydroxyapatite](#), the latter making up 70% of a bone. [[Tözeren, Aydın \(2000\). Human Body Dynamics.wikipedia.org](#)]

2-1-3-6 Endocrine regulation

Bone cells release a hormone called [osteocalcin](#), which contributes to the regulation of [blood sugar \(glucose\)](#) and [fat deposition](#). Osteocalcin increases both the [insulin](#) secretion and sensitivity, in addition to boosting the number of [insulin-producing cells](#) and reducing stores of fat. [[Lee, Na Kyung; et al. \(10 August 2007\). wikipedia.org](#)]

2-1-3-7 Sex-based differences

There are many differences between the male and female human skeletons. Most prominent is the difference in the pelvis, owing to characteristics required for the processes of [childbirth](#). The shape of a female pelvis is flatter, more rounded and

proportionally larger to allow the head of a fetus to pass. A male's pelvis is about 90 degrees or less of angle, whereas a woman's is 100 degrees or more. Also, the coccyx of a female's pelvis is oriented more inferiorly whereas the man's coccyx is usually oriented more anteriorly. This difference allows more room for a developing fetus. Men tend to have slightly thicker and longer limbs and digit bones ([phalanges](#)), while women tend to have narrower [rib cages](#), smaller teeth, less angular [mandibles](#), less pronounced cranial features such as the brow ridges and [external occipital protuberance](#) (the small bump at the back of the skull), and the carrying angle of the forearm is more pronounced in females. Females also tend to have more rounded shoulder blades

- 1) Its 206 bones form a rigid framework to which the softer tissues and organs of the body are attached.
- 2) Vital organs are protected by the skeletal system. The brain is protected by the surrounding skull as the heart and lungs are encased by the sternum and rib cage.
- 3) Bodily movement is carried out by the interaction of the muscular and skeletal systems. For this reason, they are often grouped together as the musculo-skeletal system. Muscles are connected to bones by tendons. Bones are connected to each other by ligaments. Where bones meet one another is typically called a *joint*. Muscles which cause movement of a joint are connected to two different bones and contract to pull them together. An example would be the contraction of the biceps and a relaxation of the triceps. This produces a bend at the elbow. The contraction of the triceps and relaxation of the biceps produces the effect of straightening the arm.
- 4) Blood cells are produced by the marrow located in some bones. An average of 2.6 million red blood cells is produced each second by the bone marrow to replace those worn out and destroyed by the liver.

5) Bones serve as a storage area for minerals such as calcium and phosphorus. When an excess is present in the blood, buildup will occur within the bones. When the supply of these minerals within the blood is low, it will be withdrawn from the bones to replenish the supply. The human skeleton is divided into two distinct parts: The axial skeleton and the appendicular skeleton. (Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001))

Axial Skeleton:

The axial skeleton consists of bones that form the axis of the body and support and protect the organs of the head, neck, and trunk. It is made up of:

i) The Skull: The skull is the bony framework of the head. It consists of the eight cranial and fourteen facial bones.

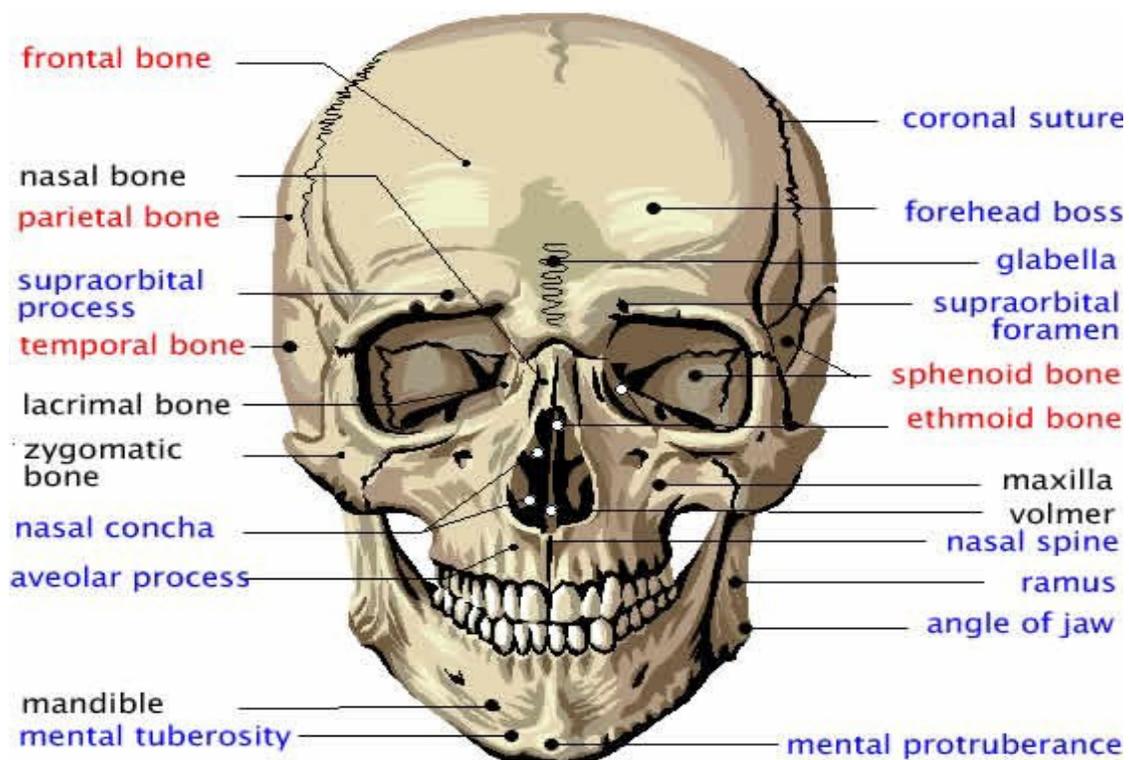


Fig 2-2: The human Skull

<http://en.wikipedia.org/wiki/Skull>

A. The cranial bones make up the protective frame of bone around the brain.

The cranial bones are:

- The frontal forms part of the cranial cavity as well as the forehead, the brow ridges and the nasal cavity.
- The left and right parietal forms much of the superior and lateral portions of the cranium.
- The left and right temporal form the lateral walls of the cranium as well as housing the external ear.
- The occipital forms the posterior and inferior portions of the cranium. Many neck muscles attach here as this is the point of articulation with the neck.
- The sphenoid forms part of the eye orbit and helps to form the floor of the cranium.
- The ethmoid forms the medial portions of the orbits and the roof of the nasal cavity.

B. The facial bones make up the upper and lower jaw and other facial structures.

The facial bones are:

- The mandible is the lower jawbone. It articulates with the temporal bones at the temporomandibular joints. This forms the only freely moveable joint in the head. It provides the chewing motion.
- The left and right maxilla are the upper jaw bones. They form part of the nose, orbits, and roof of the mouth.
- The left and right palatine forms a portion of the nasal cavity and the posterior portion of the roof of the mouth.

- The left and right zygomatic are the cheek bones. They form portions of the orbits as well.
- The left and right nasal form the superior portion of the bridge of the nose.
- The left and right lacrimal help to form the orbits.
- The vomer forms part of the nasal septum (the divider between the nostrils).

ii) The Sternum:

The sternum is a flat, dagger shaped bone located in the middle of the chest. Along with the ribs, the sternum forms the rib cage that protects the heart, lungs, and major blood vessels from damage.

The sternum is composed of three parts:

- The manubrium, also called the "handle".
- The body, also called the "blade" or the "gladiolus", is located in the middle of the sternum and connects the third to seventh ribs directly and the eighth through tenth ribs indirectly.
- The xiphoid process, also called the "tip", is located on the bottom of the sternum. It is often cartilaginous (cartilage), but does become bony in later years.

These three segments of bone are usually fused in adults.

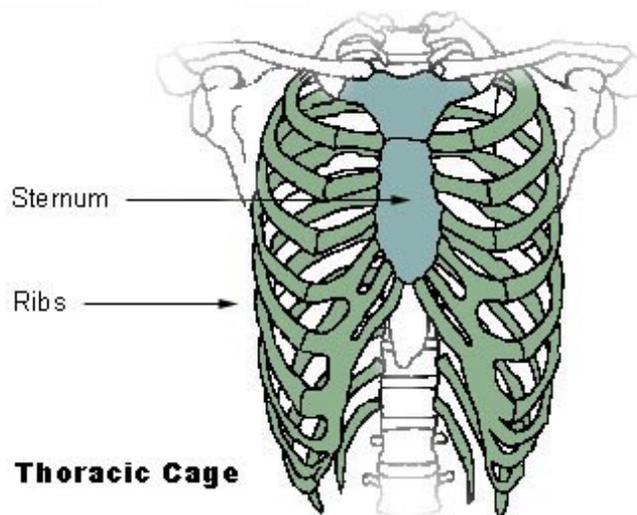


Fig 2-3: The thoracic cage

<http://en.wikipedia.org/wiki/Thoracic>

iii) The Ribs: The ribs are thin, flat, curved bones that form a protective cage around the organs in the upper body. They are comprised of 24 bones arranged in 12 pairs. These bones are divided into three categories:

- The first seven bones are called the true ribs.
 - The next three pairs of bones are called false ribs
 - The last two sets of rib bones are called floating ribs. Floating ribs are smaller than both the true ribs and the false ribs.
- The ribs form a kind of cage that encloses the upper body. They give the chest its familiar shapes.

The ribs serve several important purposes:

- They protect the heart and lungs from injuries and shocks that might damage them.
- Ribs also protect parts of the stomach, spleen, and kidneys.
- The ribs help you to breathe. As you inhale, the muscles in between the ribs lift the rib cage up, allowing the lungs to expand. When you exhale, the rib cage moves down again, squeezing the air out of your lungs.

iv) The Vertebral Column

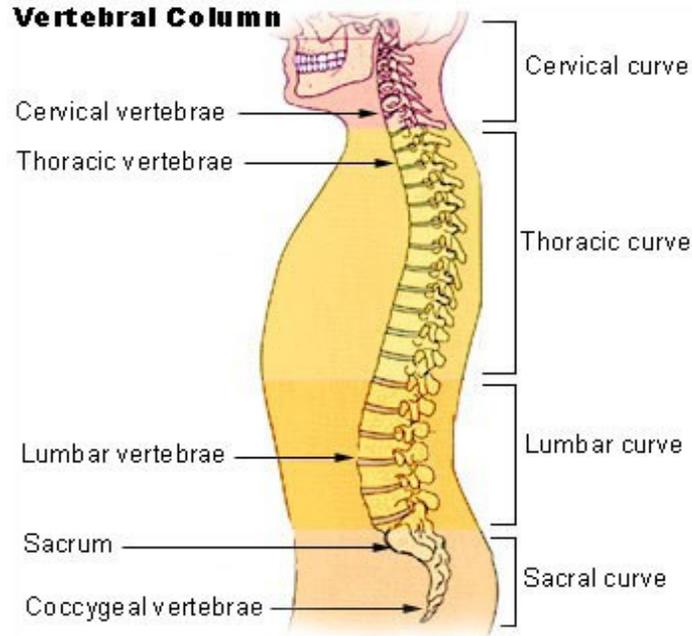


Fig 2-4: The Vertebral Column

http://en.wikipedia.org/wiki/vertebral_column.

The vertebral column (also called the backbone, spine, or spinal column) consists of a series of 33 irregularly shaped bones, called vertebrae.

These 33 bones are divided into five categories depending on where they are located in the backbone.

- The first seven vertebrae are called the cervical vertebrae. Located at the top of the spinal column, these bones form a flexible framework for the neck and support the head. The first cervical vertebra is called the atlas and the second is called the axis.

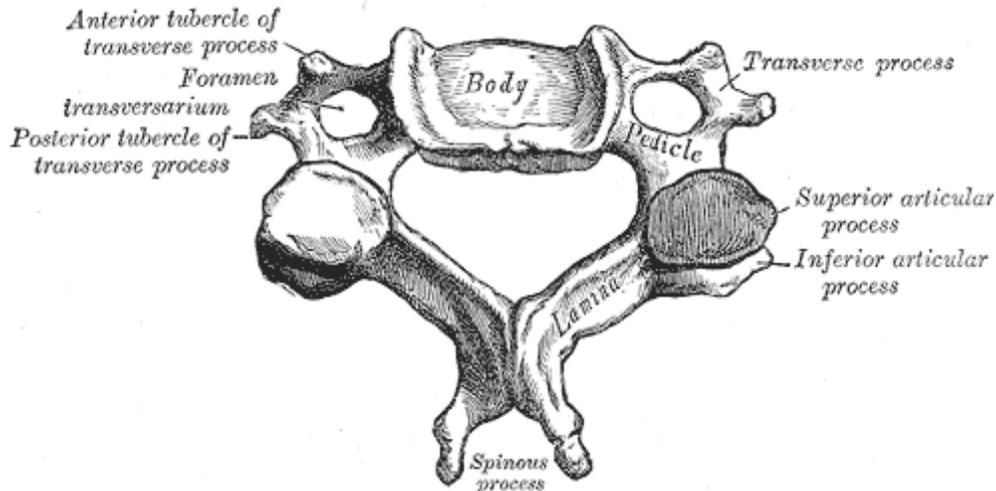


Fig 2-5: The cervical vertebrae

[http://en.wikipedia.org/wiki/Cervical vertebra](http://en.wikipedia.org/wiki/Cervical_vertebra)

- The next twelve vertebrae are called the thoracic vertebrae. These bones move with the ribs to form the rear anchor of the rib cage.
- After the thoracic vertebrae, come the lumbar vertebrae. These five bones are the largest vertebrae in the spinal column.
- The sacrum is a triangular bone located just below the lumbar vertebrae. It consists of four or five sacral vertebrae in a child, which become fused into a single bone after age 26.

The bottom of the spinal column is called the coccyx or tailbone. It consists of 3-5 bones that are fused together in an adult. Many muscles connect to the coccyx.

Intervertebral Disc

These bones compose the vertebral column, resulting in a total of 26 movable parts in an adult. In between the vertebrae are intervertebral discs made of fibrous cartilage that act as shock absorbers and allow the back to move. As a person ages, these discs compress and shrink, resulting in a distinct loss of height (generally between 0.5 and 2.0cm) between the ages of 50 and 55.



Fig 2-6: Intervertebral Disc

<http://en.wikipedia.org/wiki/disc>

When looked at from the side, the spine forms four curves. These curves are called the cervical, thoracic, lumbar, and pelvic curves. The cervical and lumbar curves are not present in an infant. The cervical curves forms around the age of 3 months when an infant begins to hold its head up and the lumbar curve develops when a child begins to walk.

In addition to allowing humans to stand upright and maintain their balance, the vertebral column serves several other important functions. It helps to support the head and arms, while permitting freedom of movement. It also provides attachment for many muscles, the ribs, and some of the organs and protects the spinal cord, which controls most bodily functions. (Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001))

The Appendicular Skeleton

The Appendicular skeleton is composed of bones that anchor the appendages to the axial skeleton.

- i) The Upper Extremities

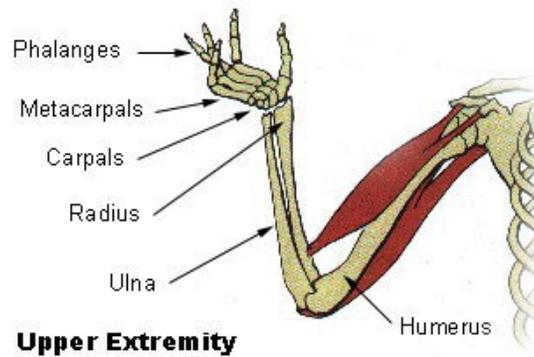


Fig 2-7: The Upper Extremities

http://en.wikipedia.org/wiki/Upper_Extremity

The upper extremity consists of three parts: the arm, the forearm, and the hand.

The arm, or brachium, is technically only the region between the shoulder and elbow. It consists of a single long bone called the humerus.

The humerus is the longest bone in the upper extremity. The top, or head, is large, smooth, and rounded and fits into the scapula in the shoulder. On the bottom of the humerus, are two depressions where the humerus connects to the ulna and radius of the forearm. Together, the humerus and the ulna make up the elbow. The bottom of the humerus protects the ulnar nerve and is commonly known as the "funny bone" because striking the elbow on a hard surface stimulates the ulnar nerve and produces a tingling sensation.

The forearm is the region between the elbow and the wrist. It is formed by the radius on the lateral side and the ulna on the medial side when the forearm is viewed in the anatomical position. The ulna is longer than the radius and connected more firmly to the humerus. The radius, however, contributes more to the movement of the wrist and hand than the ulna.

The hand consists of three parts (the wrist, palm, and five fingers) and 27 bones.

The wrist, or carpus, consists of 8 small bones called the carpal bones that are tightly bound by ligaments. These bones are arranged in two rows of four bones.

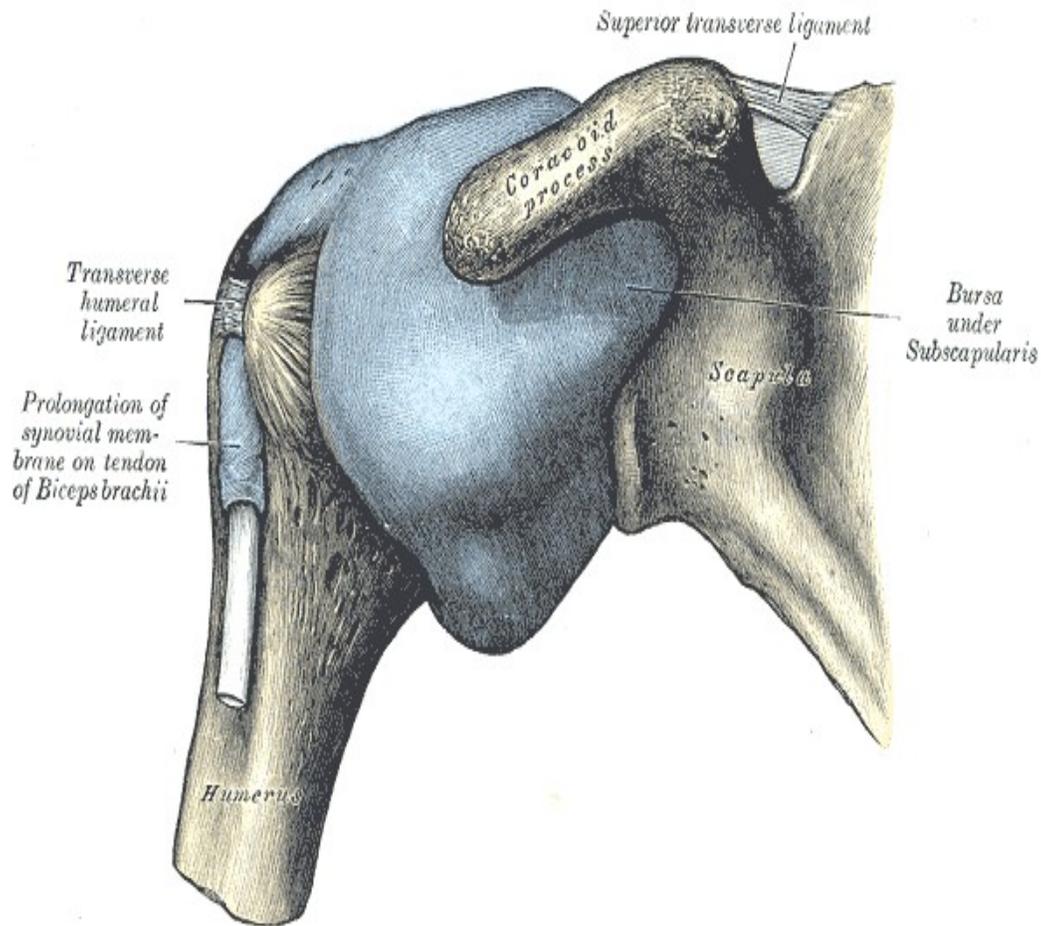


Fig 2-8: The shoulder joint

<http://en.wikipedia.org/wiki/shoulder>

ii) The Lower Extremities

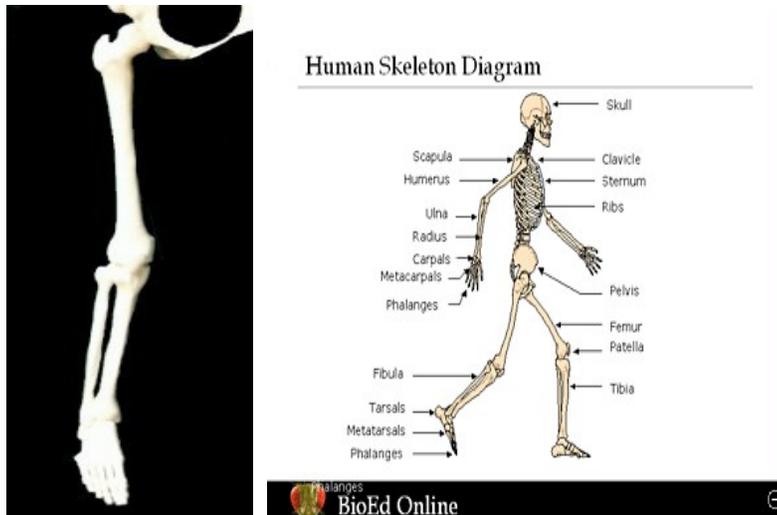


Fig 2-9: The Lower Extremities

The lower extremity is composed of the bones of the thigh, leg, foot, and the patella (commonly known as the kneecap).

The thigh is the region between the hip and the knee and is composed of a single bone called the femur or thighbone. The femur is the longest, largest, and strongest bone in the body.

The leg is technically only the region from the knee to the ankle. It is formed by the fibula on side away from the body (lateral side) and the tibia, also called the shin bone, on the side nearest the body (medial side). The tibia connects to the femur to form the knee joint and with the talus, a foot bone, to allow the ankle to flex and extend. The tibia is larger than the fibula because it bears most of the weight, while the fibula serves as an area for muscle attachment.

The foot, or pes, contains the 26 bones of the ankle, instep, and the five toes. The ankle, or tarsus, is composed of the 7 tarsal bones which correspond to the carpals in the wrist. The largest tarsal bone is called the calcaneus or heel bone. The talus rests on top of the calcaneus and is connected to the tibia. The metatarsal and phalanges bones of the foot are similar in number and position to the metacarpal and phalanges bones of the hand.

The patella or kneecap is a large, triangular sesamoid bone between the femur and the tibia. It is formed in response to the strain in the tendon that forms the knee. The patella protects the knee joint and strengthens the tendon that forms the knee. The bones of the lower extremities are the heaviest, largest, and strongest bones in the body because they must bear the entire weight of the body when a person is standing in the upright position.

iii) The Shoulder Girdle: also called the Pectoral Girdle, is composed of four bones: two clavicles and two scapulae.

The **clavicle**, commonly called the collarbone, is a slender S-shaped bone that connects the upper arm to the trunk of the body and holds the shoulder joint away from the body to allow for greater freedom of movement.

The **scapula** is a large, triangular, flat bone on the back side of the rib cage commonly called the shoulder blade. It has a shallow depression called the glenoid cavity that the head of the humerus (upper arm bone) fits into.

Usually, a "girdle" refers to something that encircles or is a complete ring. However, the shoulder girdle is an incomplete ring. In the front, the clavicles are separated by the **sternum**. In the back, there is a gap between the two scapulae.

The primary function of the pectoral girdle is to provide an attachment point for the numerous muscles that allow the shoulder and elbow joints to move. It also provides the connection between the upper extremities (the arms) and the axial skeleton

iv) **The Pelvic Girdle**--(the sacrum and coccyx are considered part of the vertebral column).

It is also called the hip girdle, is composed to two coxal (hip) bones.

During childhood, each coxal bone consists of three separate parts: the ilium, the ischium, and the pubis. In an adult, these three bones are firmly fused into a single bone.

The pelvic girdle serves several important functions in the body. It supports the weight of the body from the **vertebral column**. It also protects and supports the lower organs, including the urinary bladder, the reproductive organs, and the developing fetus in a pregnant woman.

The pelvic girdle differs between men and woman. In a man, the pelvis is more massive and the iliac crests are closer together. In a woman, the pelvis is more delicate and the iliac crests are farther apart. These differences reflect the woman's role in pregnancy and delivery of children. When a child is born, it must pass through its mother's pelvis.

If the opening is too small, a cesarean section may be necessary.

Types of Bones

The bones of the body fall into four general categories: long bones, short bones, flat bones, and irregular bones. Long bones are longer than they are wide and work as levers. The bones of the upper and lower extremities (ex. humerus, tibia, femur, ulna, metacarpals, etc.) are of this type. Short bones are short, cube-shaped, and found in the wrists and ankles. Flat bones have broad surfaces for protection of organs and attachment of muscles (ex. ribs, cranial bones, bones of shoulder girdle). Irregular bones are all others that do not fall into the previous categories. They have varied shapes, sizes, and surfaces features and include the bones of the vertebrae and a few in the skull · (Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001))

2-2 Bone composition

Bones are composed of tissue that may take one of two forms. Compact, or dense bone, and spongy, or cancellous, bone. Most bones contain both types. Compact bone is dense, hard, and forms the protective exterior portion of all bones. Spongy bone is inside the compact bone and is very porous (full of tiny holes). Spongy bone occurs in most bones. The bone tissue is composed of several types of bone cells embedded in a web of inorganic salts (mostly calcium and phosphorus) to give the bone strength, and collagenous fibers and ground substance to give the bone flexibility

Bones mass account for 20 percent of the body weight. The strength of bone comes from its inorganic components of such durability that they resist decomposition even after death. The clavicle in the shoulder is the most commonly broken bone in the body because it transmits forces from the arm to the trunk.

2-3 Disorders

There are many disorders of the skeleton. One of the most common is [osteoporosis](#).

2-3-1 Osteoporosis

Osteoporosis is a [disease](#) of [bone](#), which leads to an increased risk of [fracture](#). In osteoporosis, the [bone mineral density](#) (BMD) is reduced, bone microarchitecture is disrupted, and the amount and variety of non-[collagenous](#) proteins in bone is altered. Osteoporosis is defined by the [World Health Organization](#) (WHO) in women as a bone mineral density 2.5 [standard deviations](#) below peak bone mass (20-year-old sex-matched healthy person average) as measured by [DXA](#); the term "established osteoporosis" includes the presence of a [fragility fracture](#).^[8] Osteoporosis is most common in women after the [menopause](#), when it is called

postmenopausal osteoporosis, but may develop in men and premenopausal women in the presence of particular hormonal disorders and other [chronic](#) diseases or as a result of [smoking](#) and [medications](#), specifically [glucocorticoids](#), when the disease is termed **steroid- or glucocorticoid-induced osteoporosis** (SIOP or GIOP).

2-3-2 Deformities of Human Body

2-3-2-1 *congenital talipes equinovarus*

A **club foot**, or **congenital talipes equinovarus** (CTEV), is a congenital deformity involving one foot or both. The affected foot appears rotated internally at the ankle. TEV is classified into 2 groups: Postural TEV or Structural TEV.

Without treatment, persons afflicted often appear to walk on their ankles, or on the sides of their feet. It is a common birth defect, occurring in about one in every 1,000 live births. Approximately 50% of cases of clubfoot are bilateral.

The deformities affecting joints of the foot occur at three joints of the foot to varying degrees. They are.

- Inversion at [subtalar joint](#)
- [Adduction](#) at talonavicular joint and
- [equinus](#) at [ankle joint](#), that is, a [plantarflexed](#) position, making the foot tend towards [toe walking](#).

The deformities can be remembered using the [mnemonic](#), "**InAdEquate**" for **In**version, **Ad**duction and **E**quinus.

2-3-2-1-1 *Causes*

There are different causes for clubfoot depending on what classification it is given. Structural cTEV is caused by [genetic](#) factors such as [Edwards syndrome](#), a genetic defect with three copies of chromosome 18. Growth arrests at roughly 9 weeks and [compartment syndrome](#) of the affected limb are also causes of Structural cTEV.

Genetic influences increase dramatically with family history. It was previously assumed that postural cTEV could be caused by external influences in the final trimester such as intrauterine compression from [oligohydramnios](#) or from [amniotic band syndrome](#). However, this is countered by findings that cTEV does not occur more frequently than usual when the intrauterine space is restricted. [Breech presentation](#) is also another known cause. cTEV occurs with some frequency in [Ehlers Danlos Syndrome](#) and some other connective tissue disorders, such as [Loeys-Dietz Syndrome](#). TEV may be associated with other birth defects such as [spina bifida cystica](#). Wynne-Davies R (1972) Genetic and environmental factors in the etiology of talipes equinovarus. Clin

Orthop 84: 9–13



Fig 2-10:clubfoot before and after treatment

2-3-2-1-2What is a Club foot?

This term is used in describing a variety of abnormalities of the foot which normally are visible at birth and where the baby's foot is twisted in a strange position or shape. This term – clubfoot – is a reference to the fact that the foot is

situated with a sharp direction to the ankle – reminiscent of the head of a golfing club. This is a fairly common defect at birth and is normally a secluded condition of a newborn who is otherwise healthy. (Dr.Mary 2010-11 ByeByeDoctor..com)

Clubfoot, or talipes equinovarus, is a congenital deformity consisting of hindfoot equinus, hindfoot varus, and forefoot varus. The deformity was described as early as the time of Hippocrates. The term talipes is derived from a contraction of the Latin words for ankle, talus, and foot, pes. The term refers to the gait of severely affected patients, who walked on their ankles. The deformity can be severe, or very mild, affecting both or only one foot. Clubfoot hinders the development of the child especially when it is time for the child to start walking. For this reason clubfoot needs to begin treatment quickly after birth. Treatment is normally successful and the function as well as the appearance of the foot will show improvement. (Dr.Mary 2010-11 ByeByeDoctor..com)

2-3-2-1-3Symptoms

In the majority of cases, the deformity twists the very top of the baby's foot inward and downward, which turns the heel inmost as well as increases the arch. This foot can be twisted so seriously that in some cases it appears as if it is upside-down. The muscles in the calf of the leg which is affected are typically very weak and the affected foot can be up to 1 cm or one fourth inch shorter than the other foot. In spite of its look, clubfoot does not cause any pain or discomfort. Causes for clubfoot are not understood. But medical professionals do understand that clubfoot is not affected by the fetus' position in the uterus. In certain situation, clubfoot may be linked to other inherited abnormalities of the skeleton system, for example spina bifida, which is a severe birth flaw that happens when the tissues which surround the evolving spinal cord of the fetus does not closed properly. It is believed that in some cases factors in the environment play a part in creating clubfoot. Research has strongly suggested that clubfoot is linked to the smoking of cigarettes while

pregnant, particularly when there is a history in the family of clubfoot. (Dr.Mary 2010-11

ByeByeDoctor.com)

2-3-2-1-4Several risk factors include:

History in Family

If you or anyone in your immediate family have had this problem, the baby is much more likely to have it as well.

Smoking during pregnancy

If a woman with a family history of clubfoot smokes during pregnancy, there is a chance for the baby to also have a clubfoot.

Sex Clubfoot is most common in males.

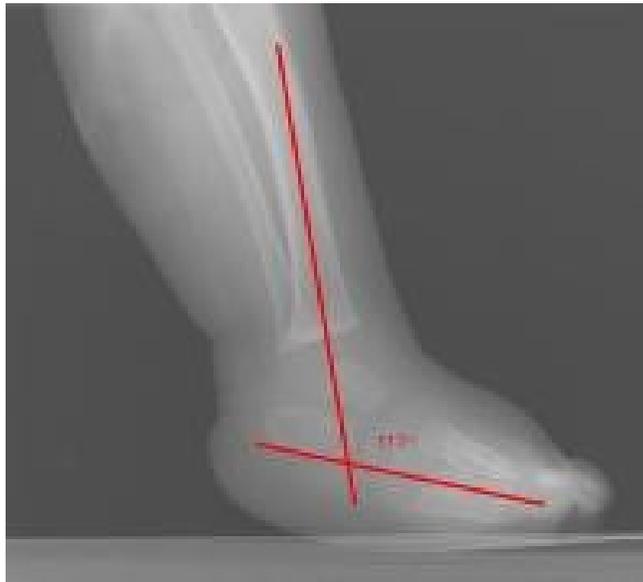


Fig 2-11: Lateral view in talipes equinovarus demonstrates an abnormally elevated tibio-calcaneal angle. A normal angle is 60-90°.



Fig 2-12: Dorsoplantar views obtained in a patient with unilateral clubfoot show that the talus and calcaneus are more overlapped than in the normal condition. The talocalcaneal angle is 15° or less. Note that the line through the long axis of the talus passes lateral to the first metatarsal due to the varus position of the forefoot.

2-3-2-1-5 Preferred examination

The standard radiologic method of evaluation is plain radiography. The equipment required is inexpensive and readily available. Evaluation should include the acquisition of only weight-bearing images because the stress involved is reproducible. In infants, weight bearing can be simulated with the application of dorsal flexion stress. (Offerdal K et al. Prenatal ultrasound detection of talipes equinovarus. 2007)

The standard views are the dorsoplantar (DP) and lateral views. For the DP view, the beam is angled 15° toward the heel to prevent overlap of the structures of the lower leg. The lateral view should include the ankle, and not the foot, for proper depiction of the talus. (Offerdal K et al. Prenatal ultrasound detection of talipes equinovarus. 2007)

Plain radiography has the disadvantage of exposing the patient to ionizing radiation. Additionally, proper positioning can be difficult. Improper positioning can simulate deformities. Further, (because clubfoot is a congenital condition, the lack of ossification in some of the involved bones is another limitation. In neonates, only the talus and calcaneus are ossified. The navicular does not ossify until the child is aged 2-3 years.) (Offerdal K, Jebens N, Blaas HG, Eik-Nes SH. Prenatal ultrasound detection of talipes equinovarus

in a non-selected population of 49 314 deliveries in Norway. *Ultrasound Obstet Gynecol.* Nov 2007;

Back deformity

2-3-2 -2Scoliosis:

Is medical condition in which a person spine is curved from side to side, although it is a complex three-dimensional deformity, on an x-ray, viewed from the rear, the spine of an individual with scoliosis may look more like an (s) or a © than a straight line. Scoliosis is typically classified as either:

- Congenital (caused by vertebral anomalies present at birth)
- Idiopathic (unknown causes)
- Neuromuscular (having developed as a secondary symptom of another condition as spina bifida, cerebral palsy) (Douglas Harper, Historian. Accessed 27 December 2008. Dictionary.com)

2-3-2-2-1Signs and symptoms

Patients having reached skeletal maturity are less likely to have a worsening case. Some severe cases of scoliosis can lead to diminishing lung capacity, putting pressure on the heart, and restricting physical activities.

The signs of scoliosis can include:

- Uneven musculature on one side of the spine
- A [rib](#) prominence and/or a prominent [shoulder blade](#), caused by rotation of the ribcage in [thoracic](#) scoliosis
- Uneven hips/leg lengths
- Slow nerve action (in some cases)

Scoliosis associated with known syndromes such as Marfan's or Prader–Willi is often sub-classified as "syndromic scoliosis.

It has been estimated that approximately 65% of scoliosis cases are [idiopathic](#), approximately 15% are [congenital](#) and approximately 10% are secondary to a [neuromuscular disease](#).

Idiopathic scoliosis is a condition which lasts a lifetime, but it does not increase the risk of mortality.

In adolescent idiopathic scoliosis, there is no clear causal agent and it is generally believed to be multifactorial, although genetics are believed to play a role. Various causes have been implicated, but none of them have consensus among scientists as the cause of scoliosis, though the role of genetic factors in the development of this condition is widely accepted. Still, at least one gene, notably [CHD7](#), has been associated with the idiopathic form of scoliosis.

In some cases, scoliosis exists at birth due to a [congenital vertebral anomaly](#). Another cause in the past was when the father had ether in his blood stream when the baby was conceived. This would happen if the man was a busy anaesthetist using ether daily in hospital operating rooms. It no longer happens because ether is not used for anaesthetic any more. Scoliosis often presents itself, or worsens, during the adolescence growth spurt and is more often diagnosed in females versus males.

2-3-2-2-2Diagnosis

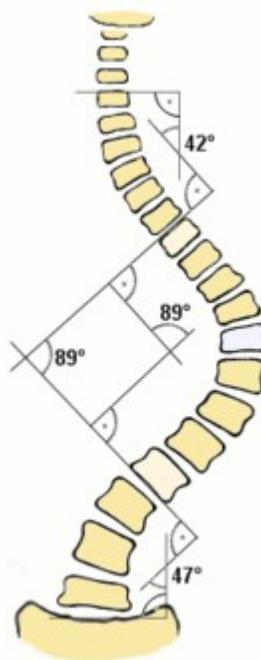


Fig 2-13: [Cobb angle](#) measurement of a levoscoliosis
<http://en.wikipedia.org/wiki/Scoliosis>

Patients who initially present with scoliosis are examined to determine whether there is an underlying cause of the deformity. During a physical examination, the following is assessed:

- [Skin](#) , indicative of [neurofibromatosis](#)
- The feet for [cavovarus deformity](#)
- Abdominal reflexes
- Muscle tone for [spasticity](#)

During the exam, the patient is asked to remove his or her shirt and bend forward. This is known as the Adams Forward Bend Test and is often performed on school students. If a prominence is noted, then scoliosis is a possibility and the patient should be sent for an X-ray to confirm the diagnosis.

As an alternative, a scoliometer may be used to diagnose the condition. The patient's [gait is assessed](#), and there is an exam for [signs](#) of other abnormalities (e.g., [spina bifida](#) , hairy patch, [lipoma](#), or [hemangioma](#)). A thorough [neurological examination](#) is also performed.

It is usual, when scoliosis is suspected, to arrange for weight-bearing full-spine AP/[coronal](#) (front-back view) and [lateral/sagittal](#) (side view) X-rays to be taken. This is to assess the scoliosis curves and the [kyphosis](#) and [lordosis](#), as these can also be affected in individuals with scoliosis. Full-length standing spine [X-rays](#) are the standard method for evaluating the severity and progression of the scoliosis, and whether it is congenital or idiopathic in nature. In growing individuals, serial radiographs are obtained at 3–12 month intervals to follow curve progression, and, in some instances, [MRI](#) investigation is warranted to look at the spinal cord.

The standard method for assessing the curvature quantitatively is measurement of the Cobb angle, which is the angle between two lines, drawn perpendicular to the upper endplate of the uppermost vertebrae involved and the lower endplate of the lowest vertebrae involved. For patients with two curves, Cobb angles are followed for both curves. In some patients, lateral-bending X-rays are obtained to assess the flexibility of the curves or the primary and compensatory curves. ["Scoliosis symptoms — pain, flat back, screening, self-assessment"](#). Iscoliosis.com. December 19, 2001

2-3-2-2-3Genetic testing

[Genetic testing for AIS](#), which became available in 2009 and is still under investigation, attempts to gauge the likelihood of curve progression.

Through a genome-wide association study, geneticists have identified single nucleotide polymorphism markers in the DNA that are significantly associated with adolescent idiopathic scoliosis. Fifty-three genetic markers have been identified. Scoliosis has been described as a biomechanical deformity,

the progression of which is dependent on asymmetric forces otherwise known as the Heuter-Volkman law. (Ogilvie J (2010). "Adolescent idiopathic scoliosis and genetic testing")

2-3-2-2-4Management

The traditional medical management of scoliosis is complex and is determined by the severity of the curvature and [skeletal maturity](#), which together help predict the likelihood of progression.

The conventional options are, in order:

1. Observation
2. Physical Therapy
3. Occupational Therapy
4. Chiropractic or Osteopathic Therapy
5. Casting (EDF)
6. [Bracing](#)
7. Surgery

A growing body of scientific research testifies to the efficacy of specialized treatment programs of physical therapy, which may include bracing. Debate in the scientific community about whether chiropractic and physical therapy can influence scoliotic curvature is partly complicated by the variety of methods proposed and employed: Some are supported by more research than other.

(Majdouline Y et al (2007). "Scoliosis correction objectives in adolescent idiopathic scoliosis". Journal of Pediatric Orthopedics)

Radiography is the mainstay in idiopathic scoliosis imaging to both confirm the diagnosis and rule out any underlying conditions. Scoliosis is the presence of 1 or more lateral rotatory curves of the spine in the coronal plane. Although defined as a side-to-side deformity, it is a 3-dimensional (3D) rotational deformity. Many causes of scoliosis are known; however, 80% of them are idiopathic. Idiopathic scoliosis is a diagnosis of exclusion.

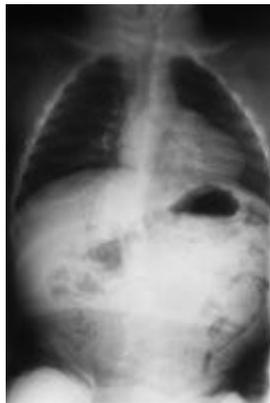


Fig 2-14: Mild juvenile scoliosis.



Fig 2-15: Moderate scoliosis.



Fig 2-16: Severe infantile scoliosis.

Most cases of scoliosis are managed conservatively, but surgery is required in select cases to arrest further progression of the deformity, to correct the curve, and to manage severe pain. Imaging plays a crucial role in confirming the diagnosis, determining the cause, grading the severity of the curve, assessing maturity, identifying patients who need surgery, and assessing postoperative complications.

American College of Radiology guidelines and recommendations

The ACR guidelines include the following:

- Indications for radiography include alterations in normal spinal alignment on physical examination, evaluation of spinal curvature progression, and follow-up of treatment
- For a scoliosis survey, the preferred method is a posteroanterior radiograph with the patient in the upright position
- For those patients who are being assessed or are being clinically treated for scoliosis, other images include right and left lateral bending images, lateral vertical beam image, and a posteroanterior image of the left wrist and the hand for bone age
- Radiographic analysis should identify the presence, direction, location, and apex of the curvature
- Skeletal maturity determination is important because mild to moderate scoliotic curves do not progress after cessation of growth

2-3-2-2-5 Preferred examination

Clinical examination should include neurologic examination to assess the deformity. A scoliometer is placed over the spinous process at the apex to measure the angle of trunk rotation (ATR). The measurement is significant if it is more than 5°.

Radiography is the mainstay in assessment of scoliosis (see the images below). It is used to confirm the clinical diagnosis of scoliosis, to exclude underlying causes (eg, segmentation abnormalities), to assess the curves and their severity, to monitor progression, to assess skeletal maturity, and to determine a patient's suitability for surgery. This study is also useful in diagnosing postoperative complications and in follow-up.



Fig 2-17: scoliotic curve

Plain radiograph illustrates the common terms used in describing the scoliotic curve. The upper and lower end vertebrae and apical vertebra are illustrated. The vertebrae and disk spaces are smaller on the concave side and larger on the convex side. The spinous process is rotated

towards the concave side. The ribs are crowded on the concave side.



Fig 2-18: vertebral rotation

Radiograph shows various grades of vertebral rotation in the spine. The pedicles are normal in the bottom vertebra, but they are moving toward the center in the upper vertebra. The spinous process is in midline in the bottom vertebra, and it is displaced in the upper vertebrae.

ADVANCE TECHNIQUE :

Bone scans are useful to evaluate cases of painful scoliosis and to identify tumors or infections. They are more sensitive than plain radiography.

CT scanning with sagittal and coronal reconstructions can provide all the information that a plain radiograph provides. With CT, 3D reconstructions are useful in assessing segmentation abnormalities. CT can also be used to assess the true extent of rotation and rib deformities. It plays an important role in evaluating postoperative complications.

The role of MRI is controversial. Although some institutes prefer to perform routine preoperative MRI in all patients, studies have shown that such an approach does not provide clinically significant results. MRI is useful for diagnosing associated spinal and neurologic lesions. Small tumors and infections can be localized by using MRI

2-3-2-2-6Limitations of techniques

The main limitation of radiography is the radiation dose. The risk of carcinogenesis is increased because of the repeated examinations done to monitor curve progression. This risk can be reduced with the judicious use of radiography and proper protection techniques.

Radiography is less sensitive than bone scanning and MRI because tumors or infections are apparent only after 50% of the bone is destroyed. Radiographs cannot be used to assess abnormalities of the spinal cord.

CT scanning is not routinely indicated, but it is a good method for assessing rotation and segmentation abnormalities. Radiography can provide all of the information needed. MRI is not cost-effective, and it is not a good screening tool because its yield in depicting important clinical abnormalities that change management is minimal.

2-3-2-3 Congenital Hip Dislocation (dysplasia)

Some children are born with a hip problem called congenital hip dislocation (dysplasia). The condition is usually diagnosed as soon as a baby is born. Most of the time, it affects the left hip in first-born children, girls, and babies born in the breech position. In hip dislocation, the ball at the top of the thighbone (femoral head) does not sit securely in the socket (acetabulum) of the hip joint. Surrounding ligaments may also be loose and stretched. The ball may be loose in the socket or completely outside of it.

Congenital hip dysplasia is an abnormal formation of the hip joint in which the ball at the top of the thighbone (femoral head) is not stable in the socket (acetabulum). Also, the ligaments of the hip joint may be loose and stretched. The degree of instability or looseness varies. A baby born with DDH may have the ball of his or her hip loosely in the socket, the looseness may worsen as the child grows and becomes more active, or the ball may be completely dislocated at birth.

Left untreated, DDH or Congenital hip dysplasia leads to pain and osteoarthritis by early adulthood. It may cause legs of different lengths or a "duck-like" walk and decreased agility. DDH has a familial tendency. It usually affects the left hip and is predominant in:

- Girls.
- First born children.
- Babies born in the breech position (especially with feet up by the shoulders). The American Academy of Pediatrics now recommends ultrasound screening of all female, breech babies.

Although Congenital hip dysplasia is usually noted in the newborn exam, treatment is easier and safer the earlier the diagnosis is made. Hips found normal at birth can be found abnormal later, but this is rare. Pediatricians screen for DDH at a newborn's first exam and at every well-baby checkup thereafter. Otherwise, the condition may not be noticed until a child begins to walk – by which time treatment is more complicated and uncertain.

2-3-2-3-1 Causes of Congenital hip dislocation

The cause of this problem is still unknown. Clinical studies show a familial tendency toward Congenital hip dysplasia, with more females affected than males. This disorder is found in many cultures

around the world. However, statistics show that the Native American population has a high incidence of hip dislocation. This has been documented to be due to the common practice of swaddling and using cradleboards for restraining the infants. This places the infant's hips into extreme adduction (brought together). The incidence of congenital Congenital hip dysplasia is also higher in infants born by caesarian and breech position births. Evidence also shows a greater chance of this hip abnormality in the first born compared to the second or third child. Hormonal changes within the mother during pregnancy, resulting in increased ligament laxity, is thought to possibly cross over to the placenta and cause the baby to have lax ligaments while still in the womb. Other symptoms of complete dislocation include a shortening of the leg and limited ability to abduct the leg.

2-3-2-3-2Symptoms of Congenital hip dislocation

In congenital dislocation, the earliest sign may be a “clicking” sound when the newborn’s legs are pushed apart. If the condition goes undetected at the newborn stage, eventually the affected leg will look shorter than the other one, skin folds in the thighs will appear uneven, and the child will have less flexibility on the affected side. When he starts to walk, he’ll probably limp, walk on his toes, or “waddle” like a duck.

Although some dislocated hips show no signs, contact a doctor if your baby has:

- Legs of different lengths.

- Uneven thigh skin folds.
- Less mobility or flexibility on one side.

In children who have begun to walk, limping, toe walking and a waddling "duck-like" gait are also signs. In addition to visual clues, doctors use careful physical examination tests to check for subtle signs of hip instability or dislocation in babies, such as listening and feeling for "clunks." Hip X-rays also may be helpful in older infants and children. Treatment methods depend upon the child's age

2-3-2-3-3Diagnosis of Congenital hip dislocation

Because the abnormalities of this hip problem often vary, a thorough physical examination is necessary for an accurate diagnosis of congenital Congenital hip dysplasia. The hip disorder can be diagnosed by moving the hip to determine if the head of the femur is moving in and out of the hip joint. One specific method, called the Ortolani test, begins with each of the examiners hands around the infant's knees, with the second and third fingers pointing down the child's thigh. With the legs abducted (moved apart), the examiner may be able to discern a distinct clicking sound with motion. If symptoms are present with a noted increase in abduction, the test is considered positive for hip joint instability. It is important to note this test is only valid a few weeks after birth.

The Barlow method is another test performed with the infant's hip brought together with knees in full bent position. The examiner's middle finger is placed over the outside of the hipbone while the thumb is placed on the inner side of the knee. The hip is abducted to where it can be felt if the hip is sliding out and then back in the joint. In older babies, if there is a lack of range of motion in one hip or even both hips, it is possible that the movement is blocked because the hip has dislocated and

the muscles have contracted in that position. Also in older infants, hip dislocation is evident if one leg looks shorter than the other. X-ray films can be helpful in detecting abnormal findings of the hip joint. X rays may also be helpful in finding the proper positioning of the hip joint for treatments of casting. Ultrasound has been noted as a safe and effective tool for the diagnosis of congenital Congenital hip dysplasia. Ultrasound has advantages over x rays, as several positions are noted during the ultrasound procedure. This is in contrast to only one position observed during the x ray. (zimmer.com)

2-3-2-3-4Treatment of Congenital hip dysplasia

The objective of treatment is to replace the head of the femur into the acetabulum and, by applying constant pressure, to enlarge and deepen the socket. In the past, stabilization was achieved by placing rolled cotton diapers or a pillow between the thighs, thereby keeping the knees in a frog like position. More recently the Pavlik harness and von Rosen splint are commonly used in infants up to the age of six months. A stiff shell cast may be used, which achieves the same purpose, spreading the legs apart and forcing the head of the femur into the acetabulum. In some cases, in older children between six to 18 months, surgery may be necessary to reposition the joint. Also at this age, the use of closed manipulation may be applied successfully, by moving the leg around manually to replace joint.

Operations are not only performed to reduce the dislocation of the hip, but also to repair a defect in the acetabulum. A cast is applied after the operation to hold the head of the femur in the correct position. The use of a home traction program is now more common. However, after the age of eight years, surgical procedures are primarily done for pain reduction measures only. Total hip surgeries may be inevitable later in adulthood.

2-3-2-3-5Alternative treatment of Congenital hip dislocation

Nonsurgical treatments include exercise programs, orthosis (a force system, often involving braces), and medications. A physical therapist may develop a program that includes strengthening, range-of-motion exercises, pain control, and functional activities. Chiropractic medicine may be helpful, especially the procedures of closed manipulations, to reduce the dislocated hip joint.

2-3-2-3-6Prognosis

Unless corrected soon after birth, abnormal stresses cause malformation of the developing femur, with a characteristic limp or waddling gait. If cases of congenital Congenital hip dysplasia go untreated, the child will have difficulty walking , which could result in life-long pain. In addition, if this condition goes untreated, the abnormal hip positioning will force the acetabulum to locate to another position to accommodate the displaced femur.

2-3-2-3-7Prevention

Prevention includes proper prenatal care to determine the position of the baby in the womb. This may be helpful in preparing for possible breech births associated with hip problems. Avoiding excessive and prolonged infant hip adduction may help prevent strain on the hip joints. Early diagnosis remains an important part of prevention of congenital Congenital hip dysplasia.



Fig 2-19: left congenital hip dislocation

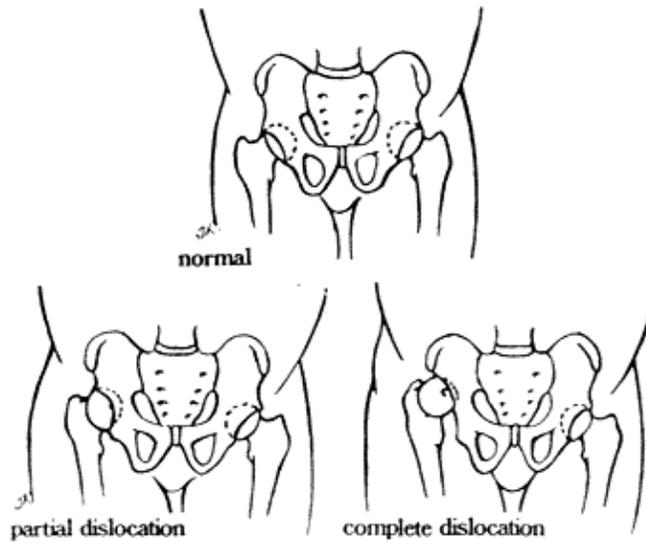


Fig 2-20: the normal and abnormal hip and pelvic shape

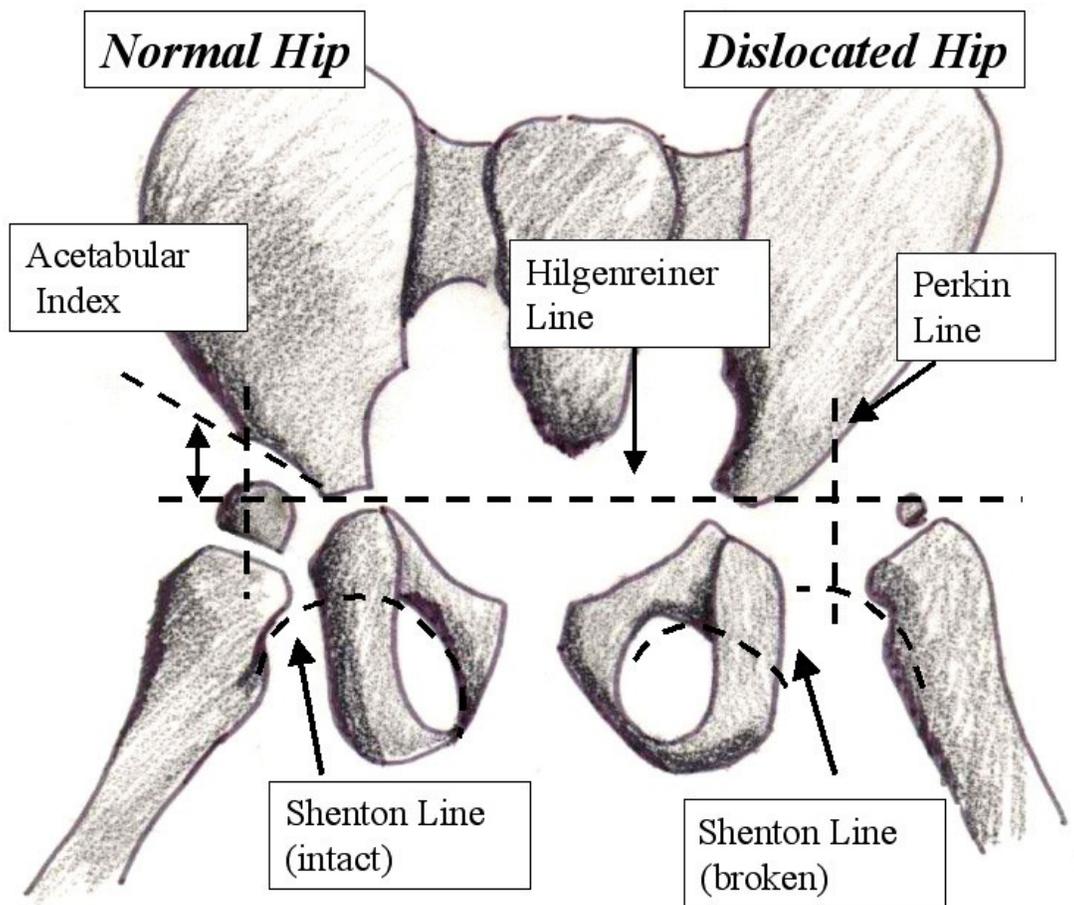


Fig 2-21: pelvic line

2-3-2-4 Rickets

Rickets is a disease of bone most commonly caused worldwide by a deficiency of vitamin D. The deficiency may be caused by a lack of vitamin D in the diet, a lack of exposure to sunlight, or a problem the body has with absorbing or using vitamin D. If left untreated, rickets results in skeletal (bone) deformities.

Vitamin D is a nutrient essential for proper bone formation. It helps regulate the amount of calcium and phosphorus in the blood, and these minerals are important components of bone formation. Vitamin D is called the "sunshine vitamin" because it is formed naturally in the skin in the presence of the ultraviolet (UV) rays found

in sunlight. Vitamin D also can be obtained from food. Vitamin D is added to milk and infant formulas, and egg yolks, liver, cod-liver oil, and other fish oils are good dietary sources of vitamin D.

What Is Rickets?

Rickets is characterized by improper hardening of the bones, resulting in skeletal deformities if left untreated. Rickets affects primarily infants and children because bone growth occurs during childhood. Rickets can occur for a number of reasons.

Rickets is an entity in which mineralization is decreased at the level of the growth plates, resulting in growth retardation and delayed skeletal development.

Osteomalacia is found within the same spectrum, affects trabecular bone, and results in undermineralization of OSTEOID bone. The term rickets is said to have derived from the ancient English word *wricken*, which means "to bend." In several European countries, rickets is also called English disease, a term that appears to stem from the fact that at the turn of the 19th century, rickets was endemic in larger British cities. By definition, rickets is found only in children prior to the closure of the growth plates, while osteomalacia occurs in persons of any age. Any child with rickets also has osteomalacia, while the reverse is not necessarily true

(<http://emedicine.medscape.com>)

2-3-2-4-1 Nutritional Childhood Rickets

Rickets can occur because of a nutritional deficiency in vitamin D. Today this type of rickets is rare in developed countries. Children growing up in poor communities where vitamin D-rich foods may be scarce are the most susceptible to rickets.

Children living in areas where there is a lack of sunshine, such as in the Northern

Hemisphere in the winter, also are susceptible. Overcast and polluted atmospheres that block out the sun can also deprive children of vitamin D. Another form of nutritional rickets is seen in extremely premature babies if they are fed a vitamin D-poor formula or if their diet contains inadequate amounts of phosphorus and calcium.

- During the 1700s, cod-liver oil and sunlight were recognized as effective treatments for rickets.
- By 1918, scientists had discovered vitamins. Experiments on animals showed that cod-liver oil had a vitamin that helped prevent rickets.
- By 1924, ultraviolet (UV) light was used for treating rickets. The process was called irradiation. Researchers understood that vitamin D was formed by the effects of ultraviolet rays on the skin.
- Between 1930 and 1931, scientists in England and Germany were able to produce pure vitamin D for the first time.

2-3-2-4-2Genetic Childhood Rickets

Rickets also can occur because of inherited genetic disorders that result in improper absorption or utilization of vitamin D, calcium, or phosphorus. In the United States, the most common cause of rickets is a disease called familial hypophosphatemia (hy-po-fos-fa-TEE-me-a), which means too little phosphorus in the blood. This is a genetic disease in which phosphorus "leaks" out of the body through the kidneys. However, fewer than 10 out of every 1 million babies are affected by this disease. (<http://emedicine.medscape.com>)

2-3-2-4-3Other Types of Rickets

Adult rickets, or osteomalacia (os-te-o-ma-LAY-sha), causes bone problems similar to those found in childhood rickets. Osteomalacia can be caused by a

nutritional deficiency of vitamin D, but it most commonly occurs when the body has problems absorbing phosphorus and calcium because of other illnesses (such as liver and kidney disease). In some instances, drugs that interfere with absorption of vitamin D cause rickets and osteomalacia. (<http://emedicine.medscape.com>)

2-3-2-4-4Symptoms

Children with rickets may not have any symptoms, or they may feel pain and develop bone deformities. A child who has or is developing rickets may experience muscle cramps, twitches, and abnormal contractions of the hands and feet due to low levels of calcium in the blood. The muscles, limbs, and abdomen grow weak and the bones of the skull remain soft. An infant with rickets may have difficulty developing such basic movements as sitting, crawling, and walking due to weakness and pain. The type of bone deformity caused by rickets depends on the age at which the disease develops. If it begins before the walking stage, the spine may be abnormally curved. If it begins or continues after the child starts to walk, the legs may become bowed by the weight of the body. For children with rickets, the teeth take more time to grow in, and often the wrists and ankles are thickened. Because of weak bones, children with rickets also are susceptible to fractures. Osteomalacia can cause similar effects: soft bones, skeletal pain, muscular weakness, and susceptibility to fractures. (<http://emedicine.medscape.com>)

2-3-2-4-5Diagnosed and Treated

Rickets can be diagnosed with blood tests, in which the amounts of calcium, phosphorus, and vitamin D are measured, and with x-rays. Nutritional rickets is treated with dietary supplements of vitamin D and calcium. If treated early enough, there will be no long-lasting effects. If untreated, a child may develop permanent

bone deformities. Dietary supplements of vitamin D, calcium, and phosphate also may be prescribed for people with rickets caused by other diseases or by genetic defects.

2-3-2-4-6How to Prevent

Rickets can be prevented by eating a diet rich in vitamin D as well as by spending time in the sun. A good source of vitamin D is vitamin D-fortified milk.

2-3-2-4-7Rickets: Clinical Features

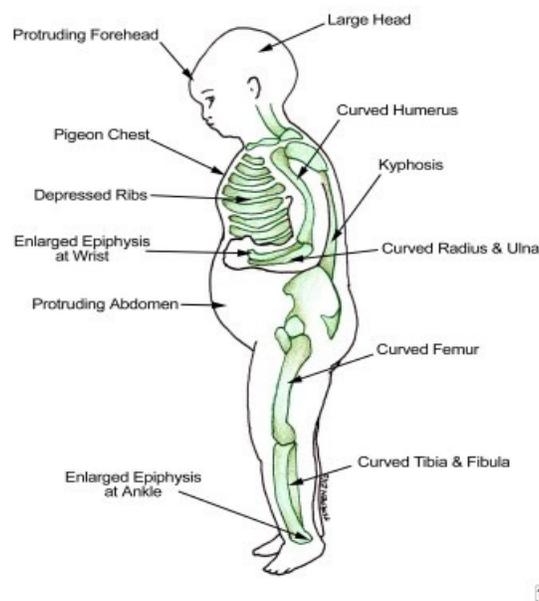


Fig 2-22: clinical feature that indicate sign of rickets

- ***Head***
 - Skull - Craniotabes may occur, in which the bones of the skull soften and flattening of the posterior skull can be seen. These effects may be transient or permanent. Another feature is the prominence of the

frontal bones and the major foramen, resulting in frontal bossing or a prominent, sometimes square, forehead (caput quadratum).

- o Teeth - Teeth may erupt later than normal because of undermineralization. Enamel can be of poor quality, resulting in caries.

- ***Thorax***

- o Rachitic rosary - The enlarged ends of the ribs, resembling beads, can be palpable and visible at the costochondral junction. As a result, the sternum can become more prominent, leading to a pigeon breast or pectus carinatum appearance.
- o Harrison groove - The groove is a semicoronal impression over the abdomen at the level of the insertion of the diaphragm, which can be seen in rickets.

- ***Spine*** - A mild to more pronounced scoliosis may be seen as a result of rickets.

- ***Pelvis*** - A prominent promontory can be found, and the anteroposterior (AP) diameter of the pelvis can shrink as a result of scoliosis. If this persists in girls, it can cause complications later in life during childbirth.

- ***Extremities***

- o Arms

- Bowing of the long bones, as a reaction to greenstick fractures, results from concurrent osteomalacia.

- Thickening of the wrist at the level of the epiphysis is not visible radiographically, since the lesion consists of cartilage, although fraying and cupping of the metaphysis is evident.
- o Legs
 - Bowing of the long bones (genu varum) as a result of weight bearing is typical.
 - Anterior bowing of the tibia (saber shin deformity) may occur.
 - Development of knock-knees (genu valgum) may occur because of displacement of the growth plates during active disease.
 - Thickening at the level of the ankle may occur, identical to the process in the wrist.
- Ligaments and muscles - Laxity in the ligaments is increased, and muscle tone is decreased. This combination leads to a delay in motor development.

2-3-2-4-8 Preferred examination

Plain radiography of the affected bones is the preferred examination. The distal radius and ulna typically demonstrate rachitic lesions early on radiographs. In preterm neonates and young infants, radiographs of the knee may be more reliable than those of the wrist. In the early stage of rickets, radiographs depict no pathology; however, chemical changes in blood serum can already be found at this time

Osteoporosis can be prevented with lifestyle advice and medication, and preventing falls in people with known or suspected osteoporosis is an established way to prevent fractures. Osteoporosis can also be prevented with having a good source of calcium and vitamin D. Osteoporosis can be treated with [bisphosphonates](#) and various other medical treatments.

2-4 x-ray equipment

2-4-1 x-ray tube

Is a component of the x-ray machine which consist of glass insert with two electrodes and an oil-filled casing into which the insert is fitted

An X-ray tube is a [vacuum tube](#) that produces [X-rays](#). They are used in [X-ray machines](#). X-rays are part of the [electromagnetic spectrum](#), an [ionizing radiation](#) with wavelengths shorter than [ultraviolet](#) light. X-ray tubes evolved from experimental [Crookes tubes](#) with which X-rays were first discovered in the late 19th century, and the availability of this controllable source of X-rays created the field of [radiography](#), the imaging of opaque objects with penetrating [radiation](#). X-ray tubes are also used in [CAT scanners](#), airport luggage scanners, [X-ray crystallography](#), and for industrial inspection.

2-4-1-1X-ray tube function:

As with any vacuum tube, there is a cathode, which emits electrons into the vacuum and an anode to collect the electrons, thus establishing a flow of electrical current, known as the beam, through the tube. A high voltage power source, for example 30 to 150 kilovolts (kV), is connected across cathode and anode to

accelerate the electrons. The X-ray spectrum depends on the anode material and the accelerating voltage.^[1] [John G. Stears, Joel P. Felmlee, and Joel E. Gray \(September 1986\), "cf., Half-Value-Layer Increase Owing to](#)

[Tungsten Buildup in the X-ray Tube: Fact or Fiction". *Radiology* 160 \(3\): 837–838.wikipedia.org\]](#)

In many applications, the current flow (typically in the range 1 mA to 1 A) is able to be pulsed on for between about 1 ms to 1 s. This enables consistent doses of X-rays, and taking snapshots of motion. Until the late 1980s, X-ray generators were merely high-voltage, AC to DC variable power supplies. In the late 1980s a different method of control was emerging, called high speed switching. This followed the electronics technology of switching power supplies (aka switch mode power supply), and allowed for more accurate control of the X-ray unit, higher quality results, and reduced X-ray exposures. Electrons from the cathode collide with the anode material, usually tungsten, molybdenum or copper, and accelerate other electrons, ions and nuclei within the anode material. About 1% of the energy generated is emitted/radiated, usually perpendicular to the path of the electron beam, as X-rays. The rest of the energy is released as heat. Over time, tungsten will be deposited from the target onto the interior surface of the tube, including the glass surface. This will slowly darken the tube and was thought to degrade the quality of the X-ray beam, but research has suggested there is no effect.^[2]

Eventually, the tungsten deposit may become sufficiently conductive that at high enough voltages, arcing occurs. The arc will jump from the cathode to the tungsten deposit, and then to the anode. This arcing causes an effect called "crazing" on the interior glass of the X-ray window. As time goes on, the tube becomes unstable even at lower voltages, and must be replaced. At this point, the tube assembly (also called the "tube head") is removed from the X-ray system, and replaced with a new tube assembly. The old tube assembly is shipped to a company that reloads it with a new X-ray tube. The X-ray photon-generating effect is generally called the

Bremsstrahlung effect, a contraction of the German *bremsen* for braking, and *strahlung* for radiation. The range of photonic energies emitted by the system can be adjusted by changing the applied voltage, and installing aluminum filters of varying thicknesses. Aluminum filters are installed in the path of the X-ray beam to remove "soft" (non-penetrating) radiation. The numbers of emitted X-ray photons, or dose, are adjusted by controlling the current flow and exposure time. Simply put, the high voltage controls X-ray penetration, and thus the contrast of the image. The tube current and exposure time affect the dose and therefore the darkness of the image. .^{[John G. Stears, Joel P. Felmlee, and Joel E. Gray (September 1986), "cf., Half-Value-Layer Increase Owing to}

[Tungsten Buildup in the X-ray Tube: Fact or Fiction". *Radiology* 160 \(3\): 837–838.wikipedia.org\]](http://www.wikipedia.org)

Rotating anode tube

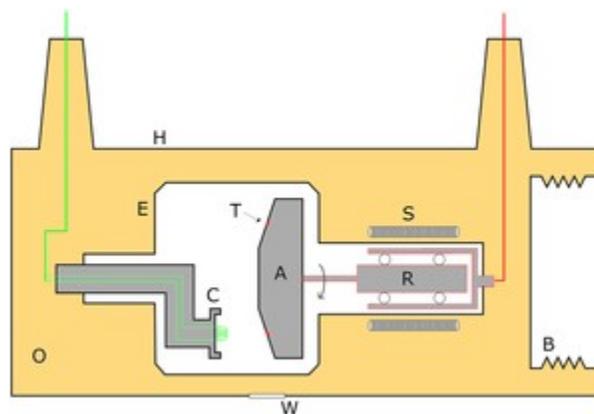


Fig 2-23: Simplified rotating anode tube schematic

<http://en.wikipedia.org/wiki/x-ray>

- A: Anode
- C: cathode
- T: Anode target
- W: X-ray window

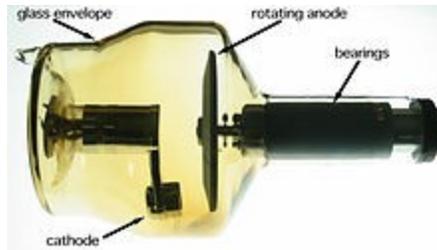


Fig 2-24: typical rotating anode X-ray tube

<http://en.wikipedia.org/wiki/x-ray>

2-4-1-2 Typical rotating anode X-ray tube

Imagine thinning the tube. The anode can then be rotated by [electromagnetic induction](#) from a series of [stator](#) windings outside the evacuated tube.

Because the entire anode assembly has to be contained within the evacuated tube, heat removal is a serious problem, further exacerbated by the higher power rating available. Direct cooling by [conduction](#) or [convection](#), as in the Coolidge tube, is difficult. In most tubes, the anode is suspended on ball bearings with silver powder lubrication which provide almost negligible cooling by conduction.

A recent development has been liquid [gallium](#) lubricated [fluid dynamic bearings](#) which can withstand very high temperatures without contaminating the tube vacuum. The large bearing contact surface and metal lubricant provide an effective method for conduction of heat from the anode.

The anode must be constructed of high temperature materials. The focal spot temperature can reach 2,500 °C (4,530 °F) during an exposure, and the anode assembly can reach 1,000 °C (1,830 °F) following a series of large exposures.

Typical materials are a tungsten-rhenium target on a molybdenum core, backed with graphite. The [rhenium](#) makes the [tungsten](#) more ductile and resistant to wear from the impact of the electron beams. The [molybdenum](#) conducts heat from the target. The [graphite](#) provides thermal storage for the anode, and minimizes the rotating mass of the anode.

2-4-1-3high tension transformer:

The high voltage source which is used to accelerate electrons fast across the tube is known as the high tension generator. So to transform the voltage of the mains supply up to the thousands of volts required to operate the tube. ((from about 20---150 kv))

2-4-1-4The High Voltage Power Supply

A high voltage power supply is an important component of an X-ray generation system. When we say high voltage supply, we need to differentiate from that of commercial electricity. Keep in mind that the filament uses a relatively small voltage supply to cause small currents (mV) in the filament, while the anode of the tube requires a large voltage supply to maintain a high positive charge for acceleration of the electrons. Commercial power is commonly available as 110 volts, 220, or 440 volts. X-ray systems require very high voltages commonly in the range from 5 kilovolts (kV) to as much as 400 kV or more. So how can we supply low voltage to the filament, and high voltage to the anode? This is accomplished

by using a transformer. A transformer will allow us to supply the proper voltages to the filament and anode.

2-4-1-5 What is transformer?

Transformers are electromagnetic devices that allow a voltage of alternating current to be changed; the voltage may be increased or decreased. Two common types of transformers which are of importance to X-ray generation are step-up and step-down. Transformers are comprised of two sets of windings (coiled conductors) that are electrically isolated from each other. One set of windings is connected to a power supply and is known as the primaries. The other set of windings is connected to a load (in this case the X-ray tube) and is referred to as the secondary windings.

The principle operation of a transformer is based on induction. If you have studied electricity, you should know that when you pass current through a conductor, a magnetic field is established in and around the conductor. This magnetic field can be used to induce a voltage and current flows in a conductive material that is placed close by.

2-4-2 The Control Unit

The third essential component to a standard X-ray system is the control unit. We have discussed the tube design and the power supply, now we need to know how to control the energy and intensity of the radiation being generated. There are three principle controls to a standard X-ray system, which are the current (mA) control, the voltage (kV) control, and a timer. The first two are the most important in terms of the radiation characteristics. We will briefly describe the timer control. The controls for the system are usually housed in a panel.

2-4-2-1 Current Control

The current control on an X-ray system commonly includes some type of a panel meter or digital display with units of miliampers (mA). The control is a rheostat connected to the circuit that allows adjustment of the current in the filament of the X-ray tube. Adjusting the current being applied to the filament results in variations in the radiation intensity. Remember that the filament provides the electrons for interaction with the target. When the tube current is varied, the number of electrons being supplied to the anode (target) varies.

2-4-2-2 Voltage Control

The voltage control on an X-ray system is similar to the current control in that it includes some type of metered display and a rheostat in the circuit. The units of the meter are usually kilovolts and the control is often labeled kV. This voltage is the electrical potential between the anode and the cathode of the tube and is referred to as the tube voltage. Variations in the tube voltage affect the energy of the radiation; penetrating power varies with the voltage. Increasing the tube voltage increases the speed of the electrons interacting with the target. Remember from our previous discussions that the energy of radiation is a function of the wavelength. Increasing the energy results in a shorter wavelength X-ray photon, which has greater penetrating power.

2-4-2-3 Time Control

The third control feature of an X-ray system is the timer. The timer is no different than one you set when baking cookies. It may be an analog or digital display of some sort. The function of the timer is simply to control the duration of the exposure, in other words, how much time the tube is generating radiation. It is,

however, connected to the circuits of the system. When the time has elapsed, the system shuts down and no more radiation will be produced until the system is reset.

Timer: Is a device that control the duration of an x-ray exposure, in radiographic exposure the flow current that response in energizing the x-ray tube. It consist of mechincal or electronic devices.

Tube current: The number of electrons crossing from cathode to anode per second, is measured in milliamperes (mA). The quantity of electrons emitted by filament is determined by the temperature of the filament.

Kvp: Kilovolts peak has more effect than any other factor on image receptor because it affects beam quality and to a lesser degree influences beam quantity, A higher –quality primary beam is one with higher energy and thus is more likely to penetrate the anatomy of interest, X-ray quantity varies rapidly with changes in kvp.

2-4-3 radiographic film

2-4-3-1The base

All radiographic film consists of a base for which the other materials are applied. The film base is usually made from a clear, flexible plastic such as cellulose acetate. This plastic is similar to what you might find in a wallet for holding pictures. The principle function of the base is to provide support for the emulsion. It is not sensitive to radiation, nor can it record an image. The clarity or transparency of the film base is an important feature. Radiographic film must be capable of transmitting light. Once a film has been processed chemically, it is

subject to interpretation. This is commonly done by using a film illuminating device, which is usually a high intensity light source.

2-4-3-2The emulsion

The film emulsion and protective coating comprise the other two components and are essentially made from the same material. They are applied to the film during manufacturing and usually take on a pale yellow color with a glassy appearance. Although they are made from the same material, they offer two distinct features to the film. These features are separated into the image layer of the emulsion, and the protective layer.

2-4-3-3The protective layer

The protective layer has the important function of protecting the softer emulsion layers below. It is simply a very thin skin of gelatin protecting the film from scratches during handling. It offers very important properties to film manufacturers, which include shrinkage (during drying that forms glassy protective layers) and dissolving in warm water. It will absorb the water and swell if it is dissolved in cold water. The softer layers of the gelatin coating are technically known as the emulsion. An emulsion holds something in suspension. It is this material in suspension that is sensitive to radiation and forms the latent image on the film. During manufacturing of the film, silver bromide is added to the solution of dissolved gelatin. When the gelatin hardens the silver bromide crystals are held in suspension throughout the emulsion. Upon exposure of the film to radiation, the silver bromide crystals become ionized in varying degrees forming the latent image. Each grain or crystal of silver bromide that has become ionized can be reduced or developed to form a grain of black metallic silver. This is what forms

the visible image on the radiograph. This visible image is made up of an extremely large number of silver crystals each is individually exposed to radiation but working together as a unit to form the image.

Once a film has been exposed to radiation and possesses the latent image, it requires chemical development. The purpose of developing the film is to bring the latent image out so that it can be seen visibly. There are three processing solutions that must be used to convert an exposed film to a useful radiograph. These are the developer, stop bath, and the fixer. Each of these solutions is important in processing the image so that it may be viewed and stored over a period of time.

X-RAY FILM

The major recording medium used in radiology is X-ray film - although the situation is changing with the introduction of new technologies in recent years. The film can be exposed by the direct action of X-rays, but more commonly the X-ray energy is converted into light by intensifying screens and this light is used to expose the film, as described above. The basic structure of the film is outlined in Figure 1 below.

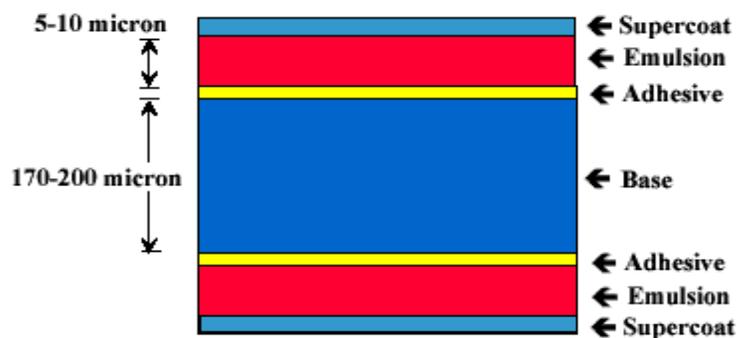


Figure 2-25: Cross-section through a double emulsion film

The film base provides the structural strength for the film. However, the base must be flexible for ease of processing, essentially be transparent to light and be dimensionally stable over time. Early base materials were glass and cellulose nitrate, but more recently cellulose triacetate and polyester have been adopted. A thin layer of adhesive is then applied to the base and this binds the emulsion layer. Covering the emulsion is a thin supercoat that serves to protect the emulsion from mechanical damage.

The two most important ingredients of a photographic emulsion are gelatin and silver halide. With most X-ray film the emulsion is coated on both sides of the film but its thickness varies with the nature and type of the film, but is usually no thicker than 10 mm. Photographic gelatin is made from bone and is ideal as a suspension medium in that it prevents clumping of grains. In addition, processing chemicals can penetrate gelatin rapidly without destroying its strength or permanence.

Silver halide is the light sensitive material in the emulsion. In X-ray film, sensitivity is increased by having a mixture of between 1% and 10% silver iodide and 90 to 99% silver bromide. In photographic emulsion the silver halide is suspended in the gelatin as small crystals (called grains). Grain size might average one to 2.3 μm in diameter with up to a billion silver ions per grain and billions of grains per ml of emulsion. In its pure form the silver halide crystal has low photographic sensitivity. The emulsion is sensitised by heating it under controlled conditions with a reducing agent containing sulphur. This results in the production of silver sulphide at a site on the surface of the crystal referred to as a sensitivity speck. It is the sensitivity speck that traps electrons to begin formation of the latent image centres.

Silver bromide is cream coloured and absorbs ultraviolet and blue light, but reflects green and red light. Historically, this was fine since the principle emission from calcium tungstate screens is blue light. Films for photography of image intensifier images and films for use with rare earth screens need to have their spectral sensitivity broadened to encompass the longer wavelengths associated with the emissions from these screens. This is accomplished by the addition of suitable dyes. (<http://www.e-radiography.net/radtech/f/film.htm>)

(Michael R Krogsgaard et al. *Acta Orthopaedica* 2006) [Increasing incidence of club foot with higher population Density](#)

The occurrence of club foot (CF) varies between countries and populations, and may be related to endogenous and exogenous factors. We analyzed the occurrence of CF in a whole country over a long period of time (16 years).

Patients born in Denmark with a foot deformity 1978–93 were identified from the National Patient Register and the Register of Inborn Malformations.

The records for each patient were studied in the hospital departments to establish the diagnoses and to obtain additional information. Demographic data were obtained from the Danish National Demographical Institute and from the Danish Population Register.

The incidence of isolated CF was 1.2/1,000 live births. It increased significantly during the study period, and the incidence of CF and the standardized morbidity ratio for CF were significantly positively correlated to population densities in the counties and the districts. There was no significant increase in the relative proportion of children with CF born to non-Scandinavian parents during the period.

Interpretation The increasing incidence of isolated CF with higher population density indicates that there may be exogenous factors that are pathogenic.

(

(Rajesh ,2003), Incidence of Congenital Malformations of the MusculoSkeletal System in New Live Borns in Jammu , Two thousand new live born babies were examined for various musculo-skeletal congenital malformations. The overall incidence of various musculo-skeletal congenital malformations was 13 per thousand live births. The per thousand incidence of talipes, neonatal hip dysplasia, polydactyly, spina bifida cystica, genu recurvatum, arthrogryposes multiplex congenita and absence of fibula was 5.5, 2.5, 2.5, 2.0 1.0, 0.5, and 0.5 respectively, Relationship of the incidence with environmental factors such as socioeconomic status, season at the time of birth, parental age, parity, presentation, maternal nutritional status and dietary habits, consanguinity, religion, urban-rural status and history of use of drugs etc, during the pregnancy have been studied. Attempt has been made to delineate the various problems in the management of neonates born with these malformations.

(Wilmington et al 1999) Types of persistent dysplasia in congenital dislocation of the hip

This article reports five types of persistent bony dysplasia in patients with congenital dislocation of the hip (CDH), suggests the pathogeneses, and discusses the treatment options. We consider the five types to be (1) maldirected acetabulum, (2) capacious acetabulum, (3) false acetabulum, (4) lateralized acetabulum, and (5) femoral deformity. The maldirected acetabulum persists when the acetabulum continues to face forward and laterally. The capacious acetabulum arises from joint instability; capsular laxity permits the proximal femur to slide within the acetabulum. The false acetabulum results from an ectopic fibrocartilaginous cavity in the pelvis created by the subluxated or dislocated femoral head.⁴⁴ The lateralized acetabulum occurs with ossification of the cotyloid cavity from longstanding lateral subluxation or dislocation or premature closure of the triradiate cartilage. Femoral deformities include valgus and anteversion of the femoral neck, capital femoral physeal growth arrest, discrepancy between the greater trochanter and the femoral head, and femoral head asphericity. After clinical and radiographic evaluation, we believe that an understanding of the

pathogeneses and types of dysplasia will facilitate appropriate treatment programs. Treatments consist of acetabular redirection, acetabular reconstruction, femoral osteotomies, and salvage procedures.

The incidence of congenital malformations in a Turkish population

To determine the incidence and types of congenital anomalies in a Turkish population. Method: The total number of neonates (9160) born in the Department of Obstetrics and Gynecology, Gazi University Faculty of Medicine during 1988–1995 were studied retrospectively. Newborns with congenital anomaly were identified from their birth registries. The total incidence, types and combined anomalies were determined. Also, the relationship between congenital anomalies and maternal age and/or gender were investigated. For statistical evaluation, Chi-square test, Yates correction and Fisher's exact tests were used where appropriate. Results: The overall congenital anomaly incidence was 1.11% and the NTD incidence was 0.27% in our population. Anencephaly was the second most common NTDs with the ratio of 40%, following the spina bifida cases. There was a significant difference between female and male newborns with anencephaly ($P < 0.05$). Urogenital system anomalies were found to be the second most common type of malformation with an incidence of 0.21%. Facial and musculoskeletal system abnormalities were the third and fourth most common malformations.

Omphalocele incidence in our population was 5 in 9160 births and gastrochisis was 1 in 9160 births. Conclusion: The overall congenital anomaly incidence in newborns in our population is 1.11%. The most common malformations were CNS and urogenital abnormalities. NTDs incidence was 0.27% in a Turkish population.

Rogala EJ (1978) Scoliosis: incidence and natural history. A prospective epidemiological study A prospective study was carried out of the incidence and natural history of adolescent idiopathic scoliosis in 26,947 students. Data were obtained on 1,122 students with idiopathic scoliosis. The incidence of idiopathic scoliosis was 4.5 per cent. The female-to-male ratio was 1.25:1.0 over-all, but the ratio varied directly with the severity of the curve--that is, 1:1 for curves of 6 to 10 degrees, and 5.4:1 for curves of more than 20 degrees. Progression of the curve was determined by a two-year follow-up of 603 patients. Progression was observed in 6.8 per cent of the students and in 15.4 per cent of the skeletally immature girls with scoliosis of more than 10 degrees at the initial examination. In 20 per cent of the skeletally immature children with curves of 20 degrees at the initial examination, there was no progression. Spontaneous improvement of the curve occurred in 3 per cent and was

seen more frequently in curves milder than 11 degrees. Treatment was required in 2.75 students per 1,000 screened.

Chapter Three

Materials & Methods

3-1-Place & time of the study

The data of this study would be gathered from the reports database of statistics information in (dar sheshar), which represents population from different sectors of Sudan. The selected sample consists of 40 patients of skeletal deformities, in period of from October- 2011- January 2012).

3.2 sample size

This study included 40 subjects skeletal deformities with age range between **one month** to **16 years**

3.3 Study variable

The variables that collected from each subject included: gender, age, weight, Affected side , Affected site and planar X-ray findings .

3-4 Materials of the Study:

1. X-ray equipments

3-5 Test performance (Technique):

The specific type of scan may vary, depending on the patient's specific needs. This article provides a general overview.

3-6 Data collection:

. The collected information as age, gender, etc would be analyzed by using EXCELL soft ware to find out the correlation and to justify their results.

Chapter four

Table(4- 1) Shows patients ages in frequency and percentage.

<i>Age</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Less than 6 month</i>	<i>16</i>	<i>40%</i>
<i>6m<12m</i>	<i>8</i>	<i>20%</i>
<i>13m<24m</i>	<i>6</i>	<i>15%</i>
<i>25m<36m</i>	<i>2</i>	<i>5%</i>
<i>37<.....</i>	<i>8</i>	<i>20%</i>
<i>Total</i>	<i>40</i>	<i>100%</i>

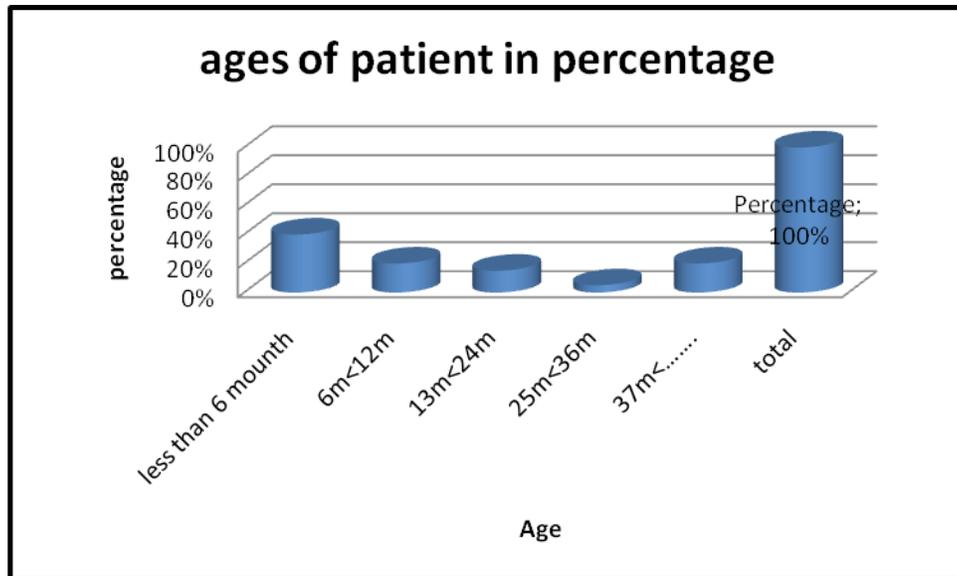


Figure (4-1) Shows patients ages in frequency

Table (4-2) shows patients gander in frequency and percentage

<i>Gander</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Male</i>	<i>25</i>	<i>62.5%</i>
<i>Female</i>	<i>15</i>	<i>37.5%</i>
<i>Total</i>	<i>40</i>	<i>100%</i>

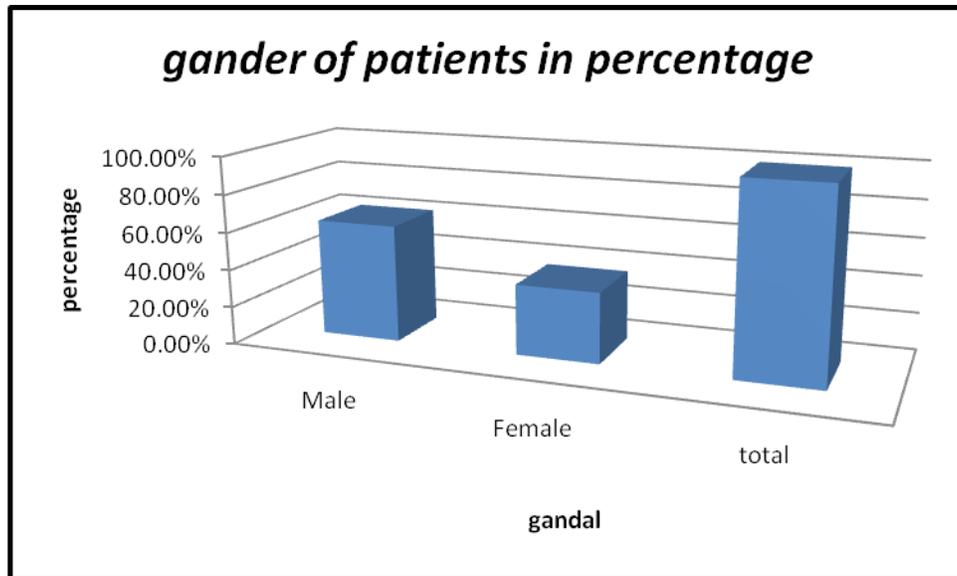


Figure (4-2) shows patients gander in frequency

Table (4-3) shows deformity type in frequency and percentage.

<i>Deformity type</i>	<i>Frequency</i>	<i>Percentage</i>
<i>Club foot(TEV)</i>	<i>25</i>	<i>62.5%</i>
<i>Knee deformity</i>	<i>5</i>	<i>12.5%</i>
<i>Hip deformity</i>	<i>2</i>	<i>5%</i>
<i>Back deformity</i>	<i>3</i>	<i>7.5%</i>
<i>Lower limb weakness</i>	<i>3</i>	<i>7.5%</i>
<i>Other deformity</i>	<i>2</i>	<i>5%</i>

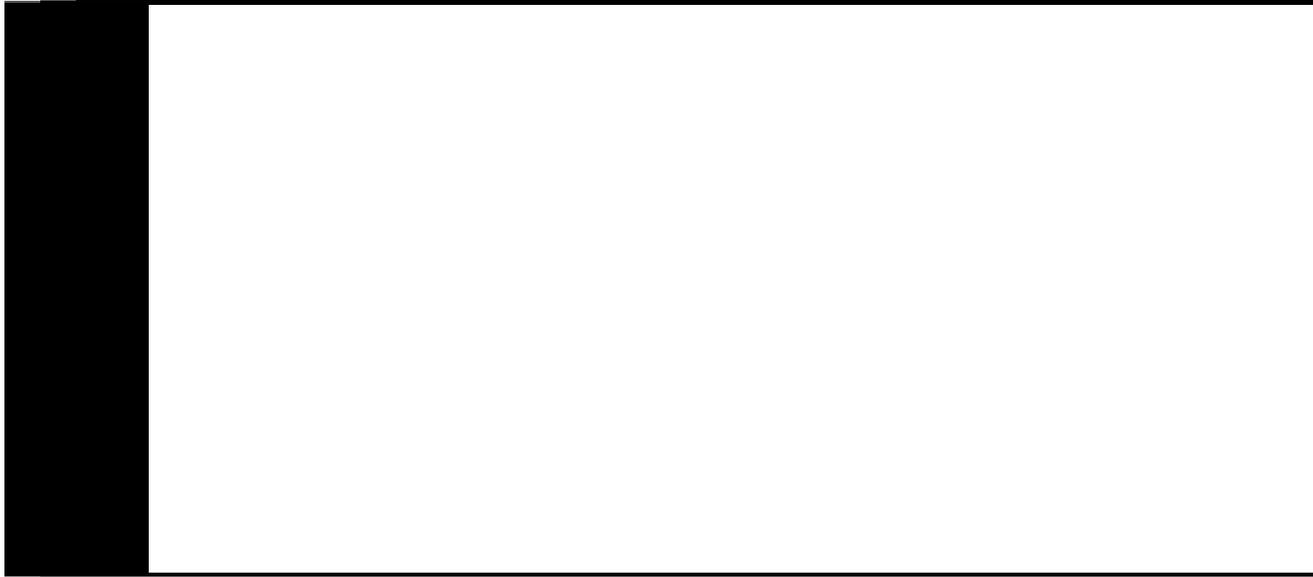


Figure (4-3) shows deformity type in frequency

Table (4-4) shows deformity spread in Sudan states according to directions in frequency and percentage.

<i>Sudan states</i>	<i>frequency</i>	<i>percentage</i>
<i>South states</i>	<i>8</i>	<i>20%</i>
<i>North states</i>	<i>5</i>	<i>12.5%</i>
<i>Medial states</i>	<i>18</i>	<i>45%</i>
<i>West states</i>	<i>4</i>	<i>10%</i>
<i>East states</i>	<i>5</i>	<i>12.5%</i>

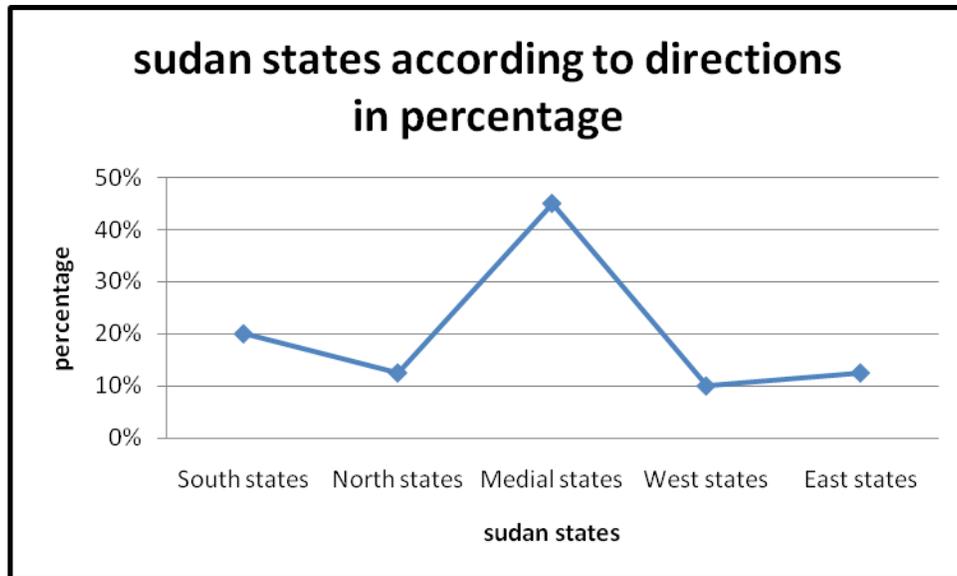


Figure (4-4) shows deformity spread in Sudan states according to directions in frequency

Table (4-5) shows the need for X-ray images for diagnosis of deformity in frequency and percentage.

<i>X-ray image</i>	<i>frequency</i>	<i>Percentage</i>
<i>Yes</i>	<i>13</i>	<i>32.5%</i>
<i>No</i>	<i>27</i>	<i>67.5%</i>

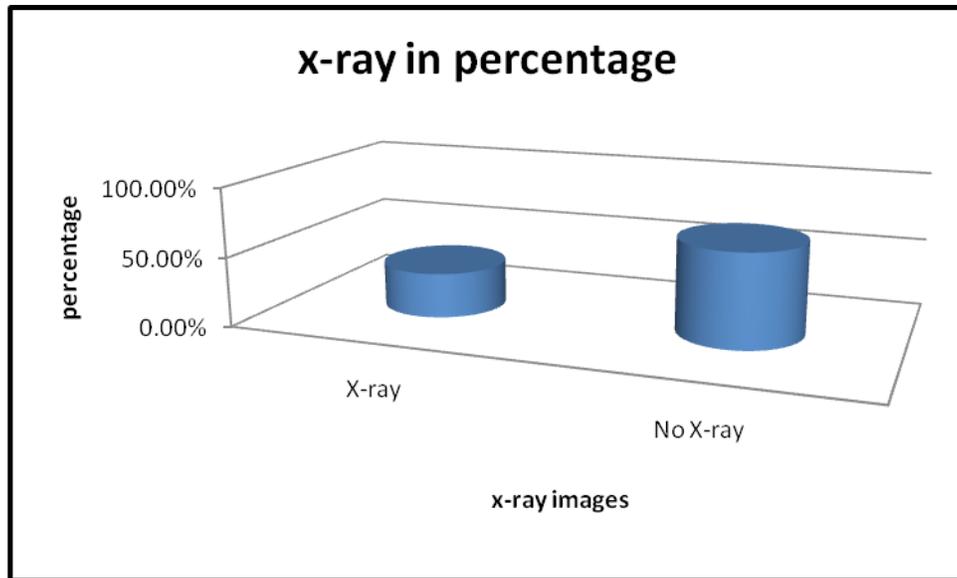


Figure (4-5) shows the need for X-ray images for diagnosis of deformity in frequency

Table (4-6) shows father and mother relation within the big family tree in frequency and percentage.

<i>Parent relation</i>	<i>frequency</i>	<i>percentage</i>
<i>Related</i>	<i>17</i>	<i>42.5%</i>
<i>Un related</i>	<i>23</i>	<i>57.5%</i>

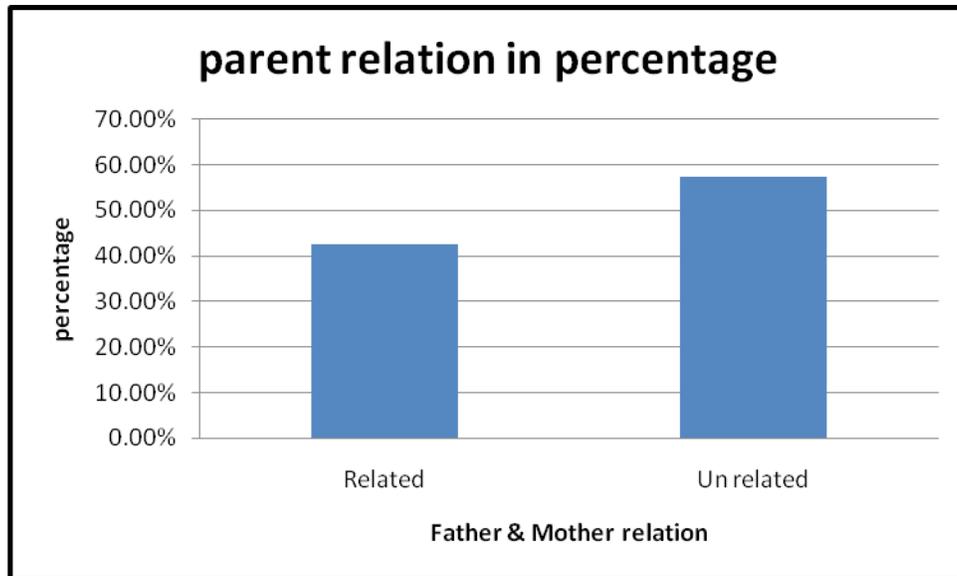


Figure (4-6) shows father and mother relation within the big family tree in frequency

Table (4-7) shows the appearance of the deformity in family history in frequency and percentage.

<i>Deformity appearance</i>	<i>frequency</i>	<i>Percentage</i>
<i>Yes there is</i>	<i>9</i>	<i>22.5%</i>
<i>No there isn't</i>	<i>31</i>	<i>77.5%</i>

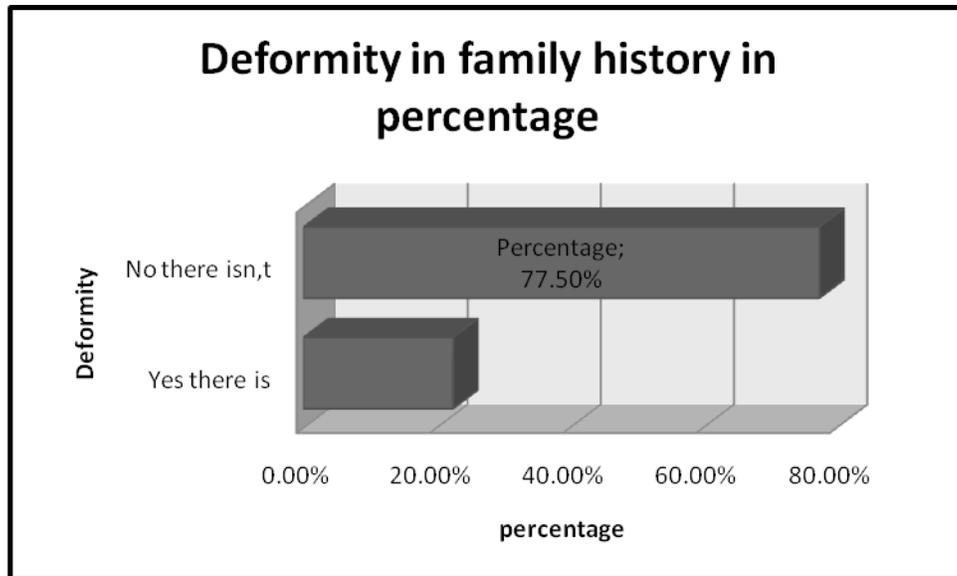


Figure (4-7) shows the appearance of the deformity in family history in frequency

Table (4-8) shows the appearance of present deformity in family history in frequency and percentage.

Present deformity in family tree	Frequency	Percentage
Father & mother are related	6	15%
Father & mother are not related	3	7.5%

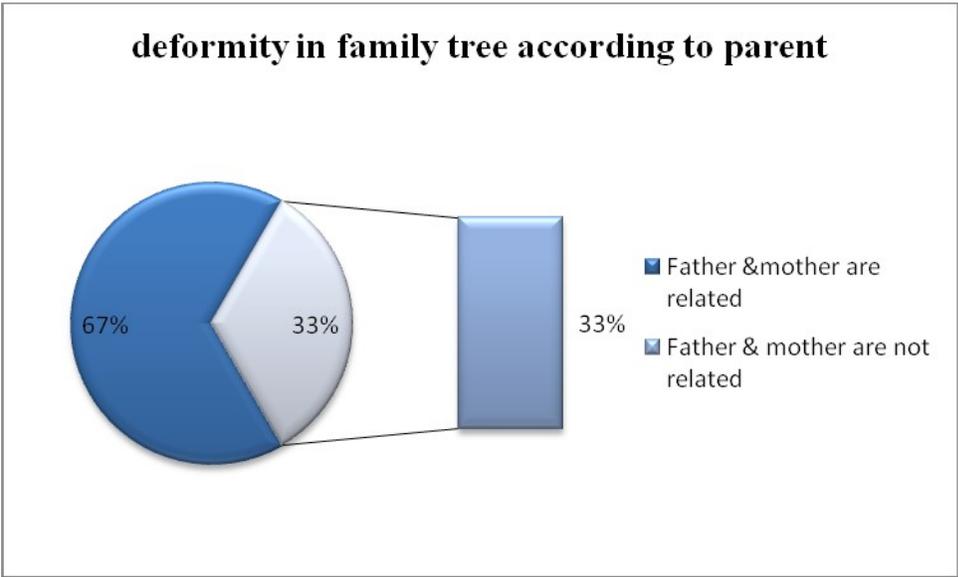


Figure (4-8) shows the appearance of present deformity in family history in frequency

Table (4-9) shows the appearance of unrecorded deformity in family history in frequency and percentage.

Deformity is not in family tree	Frequency	Percentage
Father & mother are related	14	35%
Father & mother are not related	17	42.5%

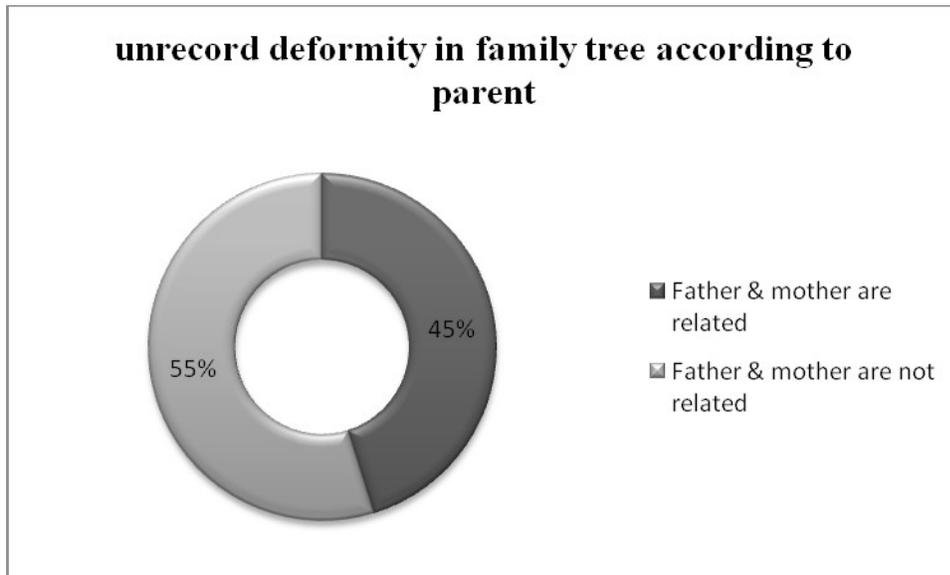


Figure (4-9) shows the appearance of unrecorded deformity in family history in frequency

Chapter five

5-1 Discussion

This study aimed to assess the deformities of skeletal system using planner X-rays. In this study, population divided into four age groups below 6month, between 7month and 12month, between 13month and 24month, and between 25month and 36month, and above 37month the most effected age group is between the newborns and 6years.

.The incidence of congenital skeletal deformities in my study was found to be apparently higher in male than female (table 4-2), because clubfoot represent the highest recorded deformity that affect male (Dr.Mary 2010), the incidence of clubfoot is 16 male to 9 female, clubfoot is a little higher than seen in medical books, But it agrees in male to female ratio that male is more affected than female,

in the clubfoot the incidence of deformity to parent related which father is not related to mother which represent 16cases from 25 cases

Knee deformity in male is higher than female (4:1) while knee deformity has slightly small different in father and mother family relation (non-relative parent (2), to relative parent (3)), the hip dislocation is (1:1) in male to female ratio, but father and mother relation of the effected child with hip dislocation are recorded that non-relative parent represent (1) case and relative parent represent (1) case. Back deformity is recorded in male only with no case in female, back or spine deformity are three recorded cases with 2 cases with non-relative parents and one with relative parent. But female to male ratio is 2:1 in lower limb weakness. The parent relations in lower limb weakness the parents are relative in 2 cases but not in 1 case. In the study I recorded a congenital deformity tibia absent in a female, and abnormal shortening of the leg in a male.

In the present series the incidence of x-ray images is not required due to the ossification of the bone physiological growth of the human this why there is only in 13 cases with an x-ray image from total of 40 cases. This high frequency of image needed is due to Illiteracy and Ignorance of family.

The family history incidence most of collected cases the deformity was not present or found in the family record or tree, so in the cases of the recorded deformity in family history which represent nine cases, six cases that their fathers and mothers are relative or from the same family but three cases are with non- relative parents, the remain 31cases that skeletal deformity is not found in family history with 14 cases that parents are from same family will 17 cases are not from same family

The centre states of the Sudan have high frequency in the country than any other state or region. South states is second then north states and east states while the last west states

5-2Conclusion

The current study aimed to Identify the classification of skeletal system deformities in pediatric, to identify the role of planner X-Ray in diagnosis and classification of different deformities among the pediatrics, and to Identify the most affected part or region of the body so to diagnosis and classify the deformity among the newborns.

There is strong no relationship between parent relations and family tree. The majority of cases present with advanced conditions because illiteracy and poverty. These results are very similar to those reported by previous authors.

All patients with old or un treated cases or deformity should undergo x-ray investigation in order to detect the morphology, function and flexibility of the affected limb, bone or joint

These results revealed that newborns were affected by clubfoot (TEV) higher than others.

5-3Recommendation

- After birth physical examination is very important in the detection and early treatment that have very high and positive outcome.
- Well trained midwife and public education is important for well knowing the normal and abnormal appearance of the newborns health in general and skeletal system specially.
- Pediatric or Patient Register and the Register of Inborn Malformation in Sudan.

Further studies on the field are needed including large date in a long period of time.

