

## Classification of Joints

The articulations are divided into three classes: **synarthroses** or immovable, **amphiarthroses** or slightly movable, and **diarthroses** or freely movable, joints.

**Synarthroses (immovable articulations).**—Synarthroses include all those articulations in which the surfaces of the bones are in almost direct contact, fastened together by intervening connective tissue or hyaline cartilage, and in which there is no appreciable motion, as in the joints between the bones of the skull, excepting those of the mandible. There are four varieties of synarthrosis: **sutura**, **schindylesis**, **gomphosis**, and **synchondrosis**.

**Sutura.**—Sutura is that form of articulation where the contiguous margins of the bones are united by a thin layer of fibrous tissue; it is met with only in the skull (Fig. 296). When the margins of the bones are connected by a series of processes, and indentations interlocked together, the articulation is termed a **true suture (sutura vera)**; and of this there are three varieties: *sutura dentata*, *serrata*, and *limbosa*. The margins of the bones are not in direct contact, being separated by a thin layer of fibrous tissue, continuous externally with the pericranium, internally with the dura mater. The **sutura dentata** is so called from the tooth-like form of the projecting processes, as in the suture between the parietal bones. In the **sutura serrata** the edges of the bones are serrated like the teeth of a fine saw, as between the two portions of the frontal bone. In the **sutura limbosa**, there is besides the interlocking, a certain degree of bevelling of the articular surfaces, so that the bones overlap one another, as in the suture between the parietal and frontal bones. When the articulation is formed by roughened surfaces placed in apposition with one another, it is termed a **false suture (sutura notha)**, of which there are two kinds: the **sutura squamosa**, formed by the overlapping of contiguous bones by broad bevelled margins, as in the squamosal suture between the temporal and parietal, and the **sutura harmonia**, where there is simple apposition of contiguous rough surfaces, as in the articulation between the maxillæ, or between the horizontal parts of the palatine bones.

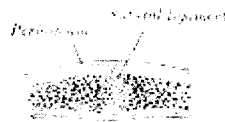


FIG. 296—Section across the sagittal suture. (See enlarged image)

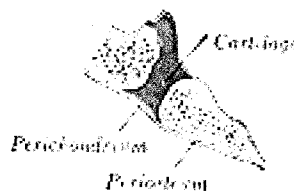
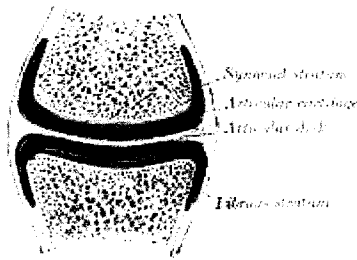


FIG. 297—Section through occipitospinous synchondrosis of an infant. (See enlarged image)

**Schindylesis.**—Schindylesis is that form of articulation in which a thin plate of bone is received into a cleft or fissure formed by the separation of two laminæ in another bone, as in the articulation of the rostrum of the sphenoid and perpendicular plate of the ethmoid with the



**FIG. 300—** Diagrammatic section of a diarthrodial joint, with an articular disk. (See enlarged image)

The varieties of joints in this class have been determined by the kind of motion permitted in each. There are two varieties in which the movement is uniaxial, that is to say, all movements take place around one axis. In one form, the **ginglymus**, this axis is, practically speaking, transverse; in the other, the **trochoid** or **pivot-joint**, it is longitudinal. There are two varieties where the movement is biaxial, or around two horizontal axes at right angles to each other, or at any intervening axis between the two. These are the **condyloid** and the **saddle-joint**.

There is one form where the movement is polyaxial, the **enarthrosis** or **ball-and-socket joint**; and finally there are the **arthrodia** or **gliding joints**.

**Ginglymus or Hinge-joint.**—In this form the articular surfaces are moulded to each other in such a manner as to permit motion only in one plane, forward and backward, the extent of motion at the same time being considerable. The direction which the distal bone takes in this motion is seldom in the same plane as that of the axis of the proximal bone; there is usually a certain amount of deviation from the straight line during flexion. The articular surfaces are connected together by strong collateral ligaments, which form their chief bond of union. The best examples of ginglymus are the interphalangeal joints and the joint between the humerus and ulna; the knee- and ankle-joints are less typical, as they allow a slight degree of rotation or of side-to-side movement in certain positions of the limb.

**Trochoid or Pivot-joint (*articulatio trochoidea; rotary joint*).**—Where the movement is limited to rotation, the joint is formed by a pivot-like process turning within a ring, or a ring on a pivot, the ring being formed partly of bone, partly of ligament. In the proximal radioulnar articulation, the ring is formed by the radial notch of the ulna and the annular ligament; here, the head of the radius rotates within the ring. In the articulation of the odontoid process of the axis with the atlas the ring is formed in front by the anterior arch, and behind by the transverse ligament of the atlas; here, the ring rotates around the odontoid process.

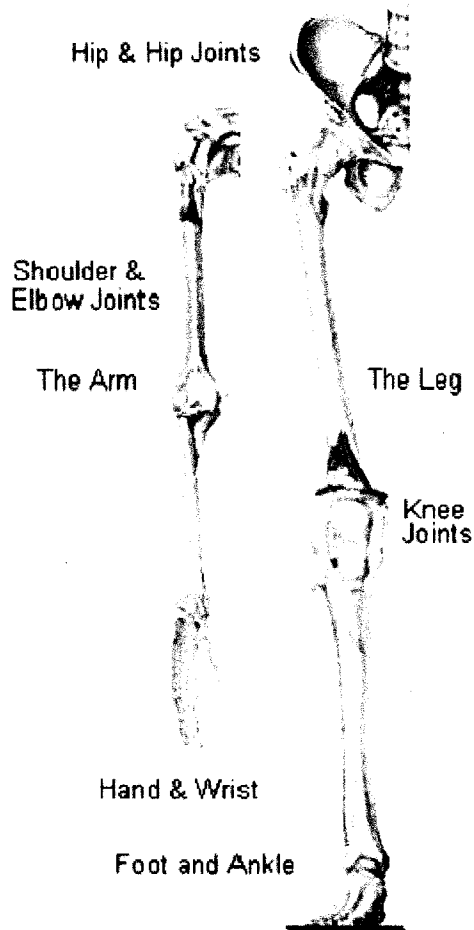
**Condyloid Articulation (*articulatio ellipsoidea*).**—In this form of joint, an ovoid articular surface, or condyle, is received into an elliptical cavity in such a manner as to permit of flexion, extension, adduction, abduction, and circumduction, but no axial rotation. The wrist-joint is an example of this form of articulation.

**Articulation by Reciprocal Reception (*articulatio sellaris; saddle-joint*).**—In this variety the opposing surfaces are reciprocally concavo-convex. The movements are the same as in the preceding form; that is to say, flexion, extension, adduction, abduction, and circumduction are allowed; but no axial rotation. The best example of this form is the carpometacarpal joint of the thumb.

**Enarthrosis (*ball-and-socket joints*).**—Enarthrosis is a joint in which the distal bone is

capable of motion around an indefinite number of axes, which have one common center. It is formed by the reception of a globular head into a cup-like cavity, hence the name "ball-and-socket." Examples of this form of articulation are found in the hip and shoulder.

**Arthrodia** (*gliding joints*) is a joint which admits of only gliding movement; it is formed by the apposition of plane surfaces, or one slightly concave, the other slightly convex, the amount of motion between them being limited by the ligaments or osseous processes surrounding the articulation. It is the form present in the joints between the articular processes of the vertebræ, the carpal joints, except that of the capitate with the navicular and lunate, and the tarsal joints with the exception of that between the talus and the navicular. <sup>15</sup>



A joint, or articulation, is the place where two bones come together. There are three types of joints classified by the amount of movement they allow: immovable, slightly movable, and freely movable.

Immovable joints are synarthroses. In this type of joint, the bones are in very close contact and are separated only by a thin layer of fibrous connective tissue. An example of a synarthrosis is the suture in the skull between skull bones.

Slightly movable joints are called amphiarthroses. This type of joint is characterized by bones that are connected by hyaline cartilage (fibro cartilage). The ribs that connect to the sternum are an example of an amphiarthrosis joint.

Most of the joints in the adult human body are freely movable joints. This type of joint is called a diarthrosis joint. There are six types of diarthroses joints. These are:

**Ball-and-Socket:** The ball-shaped end of one bone fits into a cup shaped socket on the other bone allowing the widest range of motion including rotation. Examples include the shoulder and hip.

**Condylloid:** Oval shaped condyle fits into elliptical cavity of another allowing angular motion but not rotation. This occurs between the metacarpals (bones in the palm of the hand) and phalanges (fingers) and between the metatarsals (foot bones excluding heel) and phalanges (toes).

**Saddle:** This type of joint occurs when the touching surfaces of two bones have both concave and convex regions with the shapes of the two bones complementing one other and allowing a wide range of movement. The only saddle joint in the body is in the thumb.

**Pivot:** Rounded or conical surfaces of one bone fit into a ring of one or tendon allowing rotation. An example is the joint between the axis and atlas in the neck.

**Hinge:** A convex projection on one bone fits into a concave depression in another permitting only flexion and extension as in the elbow and knee joints.

**Gliding:** Flat or slightly flat surfaces move against each other allowing sliding or twisting without any circular movement. This happens in the carpals.

## **Diseases of Joints**

**Joint diseases form one of the most important groups of crippling diseases in the world. The most common cause of arthritis in India is due to the prevailing infections of various types, whereas degenerative and metabolic joint diseases predominate in the developed countries.**

### **Anatomical and Physiological Factors**

**Synovial joints are those, Where two bones are connected by a fibrous capsule with a well defined space between them lined by the synovial membrane. The bone ends are covered with a layer of hyaline articular cartilage and in some joints there are intra-articular cartilages (Menisci) acting as cushioning and shock absorbing structures. The capsule is fibrous and is attached firmly around each articulating bone near the epiphyseal plate and is folded on itself to be attached to the periphery of the articular cartilage. the synovial membrane gets reflected similarly. The articular cartilage is avascular. The nutrition to the superficial part is by seepage of the synovial fluid between the laminations of the chondroid and to the deeper part from the vascular channels of the subchondral cancellous bone.**

Arthritis Type	Appearance	RBC per C mm	WBC per C mm	Predominand Cell type	Viscosity (Mucin Clot Test)	Sugar Mgm %
Normal Joint	Clear	A few	100	Mononuclear	Normal	90
Septic	Very Turbid	30000	80000	Polymorph	Poor	20
Tuberculous	Turbid	28000	20000	Polymorph	Poor	30
Rheumatoid	Clear	2000	15000	Polymorph	Poor	80

## Synovial Fluid

Synovial fluid is a clear, viscous, pale, yellow fluid with a gravity of 1008 to 1015, which fills the synovial cavity. It is a dialysate of the blood plasma with mucin and hyaluronic acid added to it as secretions from the synovial cells. The main functions of the synovial fluid are lubrication and nourishment of the articular cartilage. Analysis of the synovial fluid is helpful in diagnosing various types of arthritis by changes in its viscosity, cell content and biochemical features.

## CLASSIFICATION

Joints are subject to various types of diseases and disorders. Although the etiology of many of these has been recently understood, there are still many conditions where the exact etiology is not yet clear. Many lesions which are not strictly inflammatory are still loosely termed as arthritis. Diseases of joints can be classified as follows:

### I. Infective Arthritis: Bacterial, viral and parasitic:

#### a) Acute infection

1. Acute Pyogenic Arthritis
2. Acute Gonococcal Arthritis
3. Acute Rheumatic Arthritis
4. Small Pox Arthritis

#### b) Chronic infections

Non Specific: Pyogenic Arthritis

Specific: Tuberculous Arthritis, Syphilitic Arthritis & Gonococcal Arthritis

Parasitic : Guinea Worm Arthritis

### II. Rheumatoid Arthropathy

#### a) Rheumatoid Arthritis

1. Rheumatoid Arthritis (R.A.)
2. Juvenile Rheumatoid Arthritis (J.R.A.)

**b) Seronegative Spondylarthropath**

1. Ankylosing Spondylitis (A.S.)
2. Reiter's Disease
3. Psoriatic Arthritis
4. Enteropathic Arthritis

**III. Degenerative Arthrosis (Osteoarthritis) 1. Primary Osteoarthritis 2. Secondary Osteoarthritis**

**IV. Neuropathic Arthropathy 1. Charcot's arthropathy 2. Syringomyelia 3. Leprosy 4. Diabetes mellitus**

**V. Metabolic Arthritis 1. Gout 2. Pseudo Gout 3. Alkaptonuric arthritis**

**VI. Arthritis in systemic disorders**

1. Haemophilic arthritis
2. Reactive arthritis

**PATHOLOGY**

Arthritis is the inflammation of all the component structures of the joint with involvement of the synovium, articular surfaces and capsule. The following stages can be identified. I) Stage of Synovitis, II) Stage of reversible arthritis, III) Stage of irreversible arthritis and IV) Stage of ankylosis. The Critical stage of the disease is the involvement and destruction of the articular cartilage, as any gross damage to the cartilage is irreversible leading to ankylosis and loss of function.

**RHEUMATOID ARTHRITIS** Collagen diseases are systemic diseases affecting all connective tissues in the body. Many of these disorders have joint manifestations. The most important of these is Rheumatoid Arthritis. Rheumatoid arthritis is a generalised disease affecting the connective tissues of the whole body with focalised involvement of the musculoskeletal system.

**Pathology**

Rheumatoid disease is considered to be an autoimmune response to an unknown antigen and the antibody formed is the Rheumatoid factor which is identified as Immunoglobulin M (IgM). Rheumatoid arthritis is an inflammation of the synovial membrane, which becomes edematous and thickened with inflammatory exudates. Microscopy shows lymphoid follicles forming nodules with scattered cells. In the later stage, the synovium is more vascular and throws a fibrinous exudate which gets organised into a granulation tissue and spreads over the articular cartilage as the pannus. The articular cartilage gets lysed from the granulating lesion in the subchondral bone. The inflammatory process spreads

into the capsule and the periarticular tissue. During the healing process, the granular pannus becomes fibrous, uniting the joint surfaces and causing a fibrous ankylosis. The muscles around the joint also undergo inflammatory changes in the collagen tissue and get atrophied.

### **Clinical features**

Rheumatoid arthritis is more common in women and occurs between the ages of 25 and 40 years. It is a systemic disease and in the acute phase there is often a low grade fever, anaemia and constitutional disturbances. It is a chronic disease with periodic acute exacerbations and remissions. Morning stiffness is very characteristic of rheumatoid arthritis. It usually involves the small joints of the hands and feet and later on spreading to the proximal joints like the knee, hips, elbow and shoulder.

Occasionally, it may start in the knee or hip and remain as a monoarticular lesion for sometime, but soon it spreads to other joints. The presenting joint is swollen and warm. There is joint line tenderness and the movements are painful and limited. There is effusion into the joint. The synovium could be felt thickened and is tender. In the knee joint the swelling causes a fusiform appearance with pericapsular swelling. In the late stage with progressive damage to the articular cartilage, there will be increase in flexion deformity, ultimately ending in ankylosis.

In the hand, the small joints are swollen and the fingers assume a position of "ulnar deviation". The fingers assume an "*intrinsic plus deformity*" which consists of flexion at the metacarpo phalangeal joints and extension at the inter phalangeal joints. The intrinsic plus position of the fingers is due to the spasm of the intrinsic muscles of the hand which later becomes a contracture. The other deformities in the hand are a) *Boutonniere* (Buttonhole) *deformity* due to the rupture of the central slip of the extension tendon resulting in flexion at the proximal interphalangeal joint with hyperextension at the distal interphalangeal joint and b) *Swan neck deformity*, where there is hyperextension at the proximal interphalangeal joint and flexion at the distal interphalangeal joint. In the late stages, the capsular contractures become fixed, resulting in a permanent crippling deformity.

### **Diagnosis**

The essential criteria laid down by the American Rheumatism Association for the diagnosis of rheumatoid arthritis are:

1. Morning stiffness 2. Pain in one joint 3. Swelling in one joint for 6 weeks  
4. Swelling in another joint within 3 months 5. Symmetrical joint involvement  
6. Positive agglutination test
2. The patients may also show one or more of the following *nonarticular manifestations* of the Rheumatoid disease: 1. Rheumatoid tenosynovitis or bursitis e.g. Trigger finger or thumb. Carpal tunnel syndrome can be caused by the tenosynovitis in the carpal tunnel. 2. Tennis elbow - Epicondylitis of the lateral condyle of the humerus 3. Plantar fasciitis with heel pain. 4. Fibrositis

of the neck and back. The rheumatoid manifestations in other systems are subcutaneous nodules, rheumatoid pleuritis, pericarditis and small vessel vasculitis. There is general wasting of the muscles and thinning of the skin.

### **Rehabilitation**

The rehabilitation of the severely crippled patients with rheumatoid arthritis requires physiotherapy, occupational therapy and special splints and appliances to help them manage their own *self care* activities like eating, dressing, toilet etc. The modern drugs and these facilities of rehabilitation have helped many an arthritic patient, who would have been permanently bed ridden and crippled to lead an independent and useful life.

### **JUVENILE RHEUMATOID ARTHRITIS (J.R.A.)**

This is a clinical variant of rheumatoid arthritis in children and adolescents. This is of three types: a) **Systemic type** called Still's Disease, with polyarthritis, pyrexia, lymphadenitis and hepatosplenomegaly. b) **Polyarticular type** involving the joints of the hands and feet. c) **Pauciarticular type** with involvement of less than four joints usually the large joints. Clinically the orthopedic manifestations include stiffening of joints and premature epiphyseal closure. Treatment is on the same lines as for the adult type.

### **Human Parvovirus**

The human parvovirus B19 was accidentally discovered in 1974 and was classified as pathogenic. A pathogen is any substance or microorganism that produces detrimental effects on the health of the human body. Almost all viruses are considered pathogenic. The human parvovirus attacks the bones and red blood cells of humans but it is ineffectual against animals, like dogs and cats.

In the beginning, the human parvovirus did not receive much attention from researchers simply because its effects on the infected host are considered mild. When compared to other childhood diseases like measles, the parvovirus infection (called fifth disease) can be described as tame. The usual symptoms displayed by an infected child are the following:

- **Low fever** – which does not lead to convulsions or delirium
- **Red facial rash** – which gives the impression that the cheek of the infected host has been slapped. The “slapped cheek” symptom is medically called “circumoral pallor”. With this symptom, the human parvovirus infection is called “erythema infectiosum”.
- **Mild rashes** – which can be found in the body, in the arms, and in the legs. These rashes may not even appear in some cases. But when they do appear, the parvovirus infection can be considered at its second stage. Sometimes, the rashes are itchy. They may fade and then appear again.
- **Nausea and headache** – which usually happens before any of the above symptoms appear.
- **Coryza** – which refers to the excessive discharge of mucous membrane in the nose.
- **Vesicles** – which rarely happens. A vesicle is a small circular prominent lesion on the skin. The lesion is sac-like and contains fluid.



- **Scaly dermatitis** – which is an inflammation of the skin, similar to one acquired after overexposure to sunlight. The skin has become dry that it appears to be scaly.

In some infected persons, the above symptoms may not even appear. These persons will just have a vague feeling of being sick but cannot exactly pinpoint what particular sickness. They would think that they have the common flu, especially when they have coryza. This situation is what doctors refer to as “asymptomatic infection”. These people become carriers of the virus. That is, since they don’t stay in bed, they can spread the virus to other people.

Unfortunately, when the human parvovirus infects the adults, more serious symptoms are displayed. The human parvovirus attacks the bones of the adults and produces these symptoms:

- **Arthralgia** – The presence of pain in the bone joints, especially when these are moved.
- **Arthritis** – The inflammation of the joints. The human parvovirus has made the joints swollen. Some children infected with the human parvovirus may also experience this symptom.
- **Hydrops** – The abnormal accumulation of thin watery fluids in body tissues and body cavities. With all the above symptoms of the human parvovirus infection, this disease is now being considered as serious.

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## Joints

- 1) Student will know the types of joints and how they move.
- 2) Student will be able to name joints as to type.
- 3) Student will have an understanding of the knee, shoulder and elbow joints.