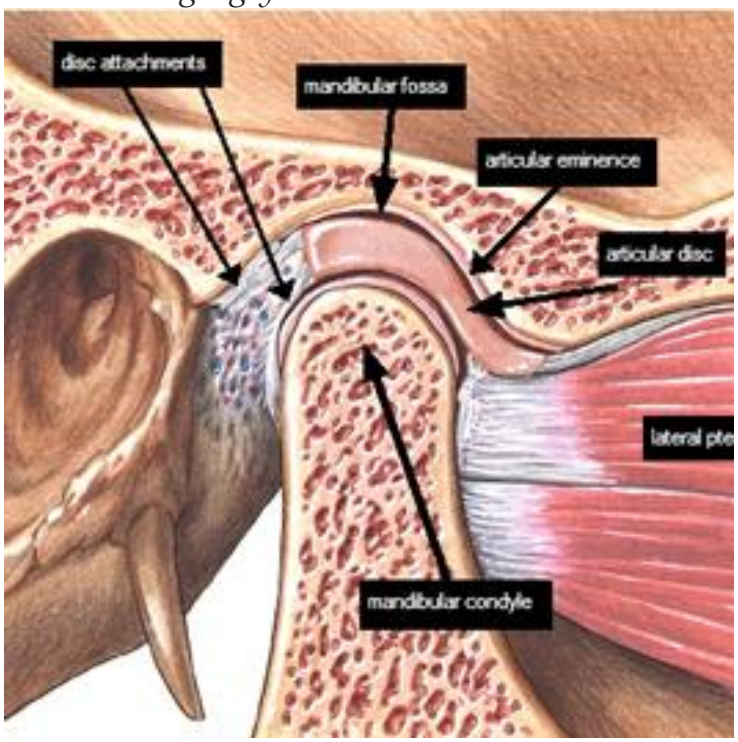
TMJ

The temporomandibular joint (TMJ) is composed of the temporal bone and the mandible, as well as a specialized dense fibrous structure, the articular disk, several ligaments, and numerous associated muscles. The TMJ is a compound joint that can be classified by anatomic type as well as by function.

Anatomically the TMJ is a diarthrodial joint, which is a discontinuous articulation of two bones permitting freedom of movement that is dictated by associated muscles and limited by ligaments. Its fibrous connective tissue capsule is well innervated and well vascularized and tightly attached to the bones at the edges of their articulating surfaces. It is also a synovial joint, lined on its inner aspect by a synovial membrane, which secretes synovial fluid. The fluid acts as a joint lubricant and supplies the metabolic and nutritional needs of the non-vascularized internal joint structures.

Functionally the TMJ is a compound joint, composed of four articulating surfaces: the articular facets of the temporal bone and of the mandibular condyle and the superior and inferior surfaces of the articular disk. The articular disk divides the joint into two compartments. The lower compartment permits hinge motion or rotation which is termed *ginglymoid*. The superior compartment permits sliding (or translatory) movements and is therefore called *arthrodial*. Hence the temporomandibular joint as a whole can be termed *ginglymoarthrodial*.



Bony Structures:
consist of **temporal bone** and **the mandible**
The articular portion of the temporal bone is composed of three parts.
The largest is the articular or mandibular fossa, a concave structure extending from the posterior slope of the articular eminence to the postglenoid process, which is a ridge between the fossa and the external acoustic meatus. The surface of the articular fossa is thin and may be translucent on a dry skull. This is not a major stress-bearing area.
The second portion, the articular eminence, is a transverse bony prominence that is continuous across the articular surface mediolaterally. The articular eminence is usually thick and serves as a major functional component of the TMJ. **The third portion** of the articular surface of the temporal bone is the preglenoid plane, a flattened area anterior to the eminence.

The mandible is a U-shaped bone that articulates with the temporal bone by means of the articular surface of its condyles. The mandibular condyle is wider mediolaterally than anterioposteriorly. The condyle tends to be rounded mediolaterally and convex anteroposteriorly. On its medial aspect just below its articular surface is a prominent depression, **the pterygoid fovea**, which is the site of attachments of the lateral pterygoid muscle.

Cartilage and Synovium:
Lining the inner aspect of all synovial joints, including the TMJ, are two types of tissue: articular cartilage and synovium. The space bound by these two structures is termed the *synovial cavity*, which is filled with synovial fluid. The articular surfaces of both the temporal bone and the condyle are covered with dense articular fibrocartilage, a fibrous connective tissue. This fibrocartilage covering has the capacity to regenerate and to remodel under functional stresses. Deep to the fibrocartilage, particularly on the condyle, is a proliferative zone of cells that may develop into either cartilaginous or osseous tissue. Most change resulting from function is seen in this layer.
Articular cartilage is composed of chondrocytes and an intercellular matrix of collagen fibers, water, and a nonfibrous filler material, termed *ground substance*.
There are few blood vessels in the cartilage, with cartilage being nourished primarily by diffusion from the synovial fluid.
Lining the capsular ligament is the synovial membrane, a thin, smooth, richly

innervated vascular tissue without an epithelium. The synovium is capable of rapid and complete regeneration following injury. Synovial fluid is considered an ultrafiltrate of plasma. It contains a high concentration of hyaluronic acid, which is thought to be responsible for the fluid's high viscosity.
Functions of the synovial fluid include lubrication of the joint, phagocytosis of particulate debris, and nourishment of the articular cartilage. The concentration of hyaluronic acid and hence the viscosity of the synovial fluid is greater at the point of load, thus protecting the articular surfaces.

The Articular Disk
The articular disk is composed of dense fibrous connective tissue and is nonvascularized and noninnervated, an adaptation that allows it to resist pressure. Anatomically the disk can be divided into three general regions :
the anterior band, **the central intermediate zone**, and **the posterior band**.
The thickness of the disk appears to be correlated with the prominence of the eminence. The intermediate zone is thinnest and is generally the area of function between the mandibular condyle and the temporal bone. The disk is flexible and adapts to functional demands of the articular surfaces. The articular disk is attached to the capsular ligament anteriorly, posteriorly, medially, and laterally. Some fibers of the superior head of the lateral pterygoid muscle insert on the disk at its medial aspect, apparently serving to stabilize the disk to the mandibular condyle during function.

Retrodiskal Tissue
Posteriorly the articular disk blends with a highly vascular, highly innervated structurewhich is **the bilaminar zone**, which is involved in the production of synovial fluid. The superior aspect of the retrodiskal tissue contains elastic fibers and is termed the ***superior retrodiskal lamina*,** which attaches to the tympanic plate and functions as a restraint to disk movement in extreme translator movements.
The inferior aspect of the retrodiskal tissue, termed the ***inferior retrodiskal lamina***, consists of collagen fibers without elastic tissue and functions to connect the articular disk to the posterior margin of the articular surfaces of the condyle. It is thought to serve as a ligament to prevent extreme rotation of the disk on the condyle in rotational movements.

Ligaments
Ligaments associated with the TMJ are composed of collagen and act predominantly as restraints to motion of the condyle and the disk.

Three ligaments which are **collateral, capsular**, and **temporomandibular ligaments** are considered functional ligaments because they serve as major anatomic components of the joints.
Two other ligaments which are **sphenomandibular** and **stylomandibular** are considered accessory ligaments because, although they are attached to osseous structures at some distance from the joints, they serve to some degree as passive restraints on mandibular motion.

The collateral (or diskal) ligaments are short paired structures attaching the disk to the lateral and medial poles of each condyle. Their function is to restrict movement of the disk away from the condyle, thus allowing smooth synchronous motion of the disk-condyle complex. Although the collateral ligaments permit rotation of the condyle with relation to the disk, their tight attachment forces the disk to accompany the condyle through its translatory range of motion.
The capsular ligament encompasses each joint, attaching superiorly to the temporal bone along the border of the mandibular fossa and eminence and inferiorly to the neck of the condyle along the edge of the articular facet. It surrounds the joint spaces and the disk, attaching anteriorly and posteriorly as well as medially and laterally, where it blends with the collateral ligaments. The function of the capsular ligament is to resist medial, lateral, and inferior forces, thereby holding the joint together. It offers resistance to movement of the joint only in the extreme range of motion. A secondary function of the capsular ligament is to contain the synovial fluid within the superior and inferior joint spaces.

The temporomandibular (lateral) ligaments are located on the lateral aspect of each TMJ. Unlike the capsular and collateral ligaments, which have medial and lateral components within each joint, the temporomandibular ligaments are single structures that function in paired fashion with the corresponding ligament on the opposite TMJ.
Each temporomandibular ligament can be separated into two distinct portions, that have different functions.
The outer oblique portion descends from the outer aspect of the articular tubercle of the zygomatic process posteriorly and inferiorly to the outer posterior surface of the condylar neck. It limits the amount of inferior distraction that the condyle may achieve in translatory and rotational movements.

The inner horizontal portion also arises from the outer surface of the articular tubercle, just medial to the origin of the outer oblique portion of the ligament, and runs horizontally backward to attach to the lateral pole of the condyle and the posterior aspect of the disk. The function of the inner horizontal portion of the temporomandibular ligament is to limit posterior movement of the condyle, particularly during pivoting movements, such as when the mandible moves laterally in chewing function. This restriction of posterior movement serves to protect the retrodiskal tissue.

The sphenomandibular ligament arises from the spine of the sphenoid bone and descends into the fan-like insertion on the mandibular lingula, as well as on the lower portion of the medial side of the condylar neck. The sphenomandibular ligament serves to some degree as a point of rotation during activation of the lateral pterygoid muscle, thereby contributing to translation of the mandible.

The stylomandibular ligament descends from the styloid process to the posterior border of the angle of the mandible and also blends with the fascia of the medial pterygoid muscle. It functions similarly to the sphenomandibular ligament as a point of rotation and also limits excessive protrusion of the mandible.

Vascular Supply and Innervation

The vascular supply of the TMJ arises primarily from branches of the superficial temporal and maxillary arteries posteriorly and the masseteric artery anteriorly. There is a rich plexus of veins in the posterior aspect of the joint associated with the retrodiskal tissues, which alternately fill and empty with protrusive and retrusive movements, respectively, of the condyle disk complex and which also function in the production of synovial fluid.

The nerve supply to the TMJ is predominantly from branches of the auriculotemporal nerve with anterior contributions from the masseteric nerve and the posterior deep temporal nerve.

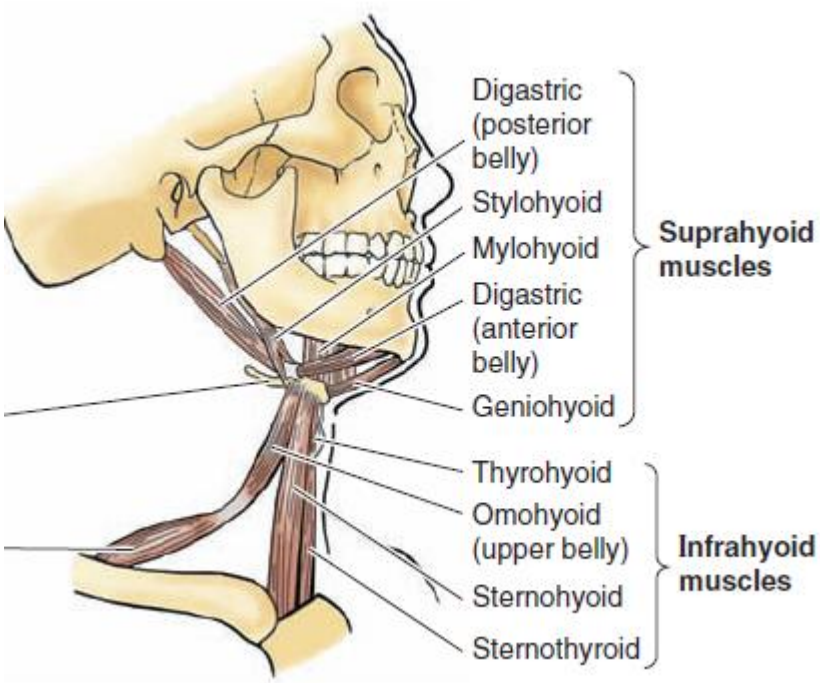
Musculature

All muscles attached to the mandible influence its movement to some degree. Only the four large muscles that attach to the ramus of the mandible are considered the muscles of mastication; however, a total of 12 muscles actually influence mandibular motion, all of which are bilateral. Muscle pairs may function together for symmetric movements or unilaterally for asymmetric

movement. For example, contraction of both lateral pterygoid muscles results in protrusion and depression of the mandible without deviation, whereas contraction of one of the lateral pterygoid muscles results in protrusion and opening with deviation to the opposite side.
Muscles influencing mandibular motion may be divided into two groups by anatomic position. Attaching primarily to the ramus and condylar neck of the mandible is the **supramandibular muscle group**, consisting of the temporalis, masseter, medial pterygoid, and lateral pterygoid muscles. This group functions predominantly as the elevators of the mandible. The lateral pterygoid does have a depressor function as well. Attaching to the body and symphyseal area of the mandible and to the hyoid bone is the **inframandibular group**, which functions as the depressors of the mandible. The inframandibular group includes the four **suprahyoid** muscles (digastric, geniohyoid, mylohyoid, and stylohyoid) and the four **infrahyoid** muscles (sternohyoid, omohyoid, sternothyroid, and thyrohyoid).
The suprahyoid muscles attach to both the hyoid bone and the mandible and serve to depress the mandible when the hyoid bone is fixed in place. They also elevate the hyoid bone when the mandible is fixed in place. The infrahyoid muscles serve to fix the hyoid bone during depressive movements of the mandible.

Supramandibular Muscle Group
These include the four muscles of mastication

Inframandibular Muscle Group
The inframandibular muscles can be subdivided into two groups: **the suprahyoids** and **the infrahyoids**.
The suprahyoid group consists of the digastric, geniohyoid,mylohyoid, and stylohyoid muscles; lies between the mandible and the hyoid bone; and serves to either raise the hyoid bone, if the mandible is fixed in position by the Supramandibular group, or depress the mandible, if the hyoid bone is fixed in position by the infrahyoids.
The infrahyoid group, consisting of the sternohyoid, omohyoid, sternothyroid, and thyrohyoid muscles, attaches to the hyoid bone superiorly and to the sternum, clavicle, and scapula inferiorly. This group of muscles can either depress the hyoid bone or hold the hyoid bone in position, relative to the trunk, during opening movements of the mandible.

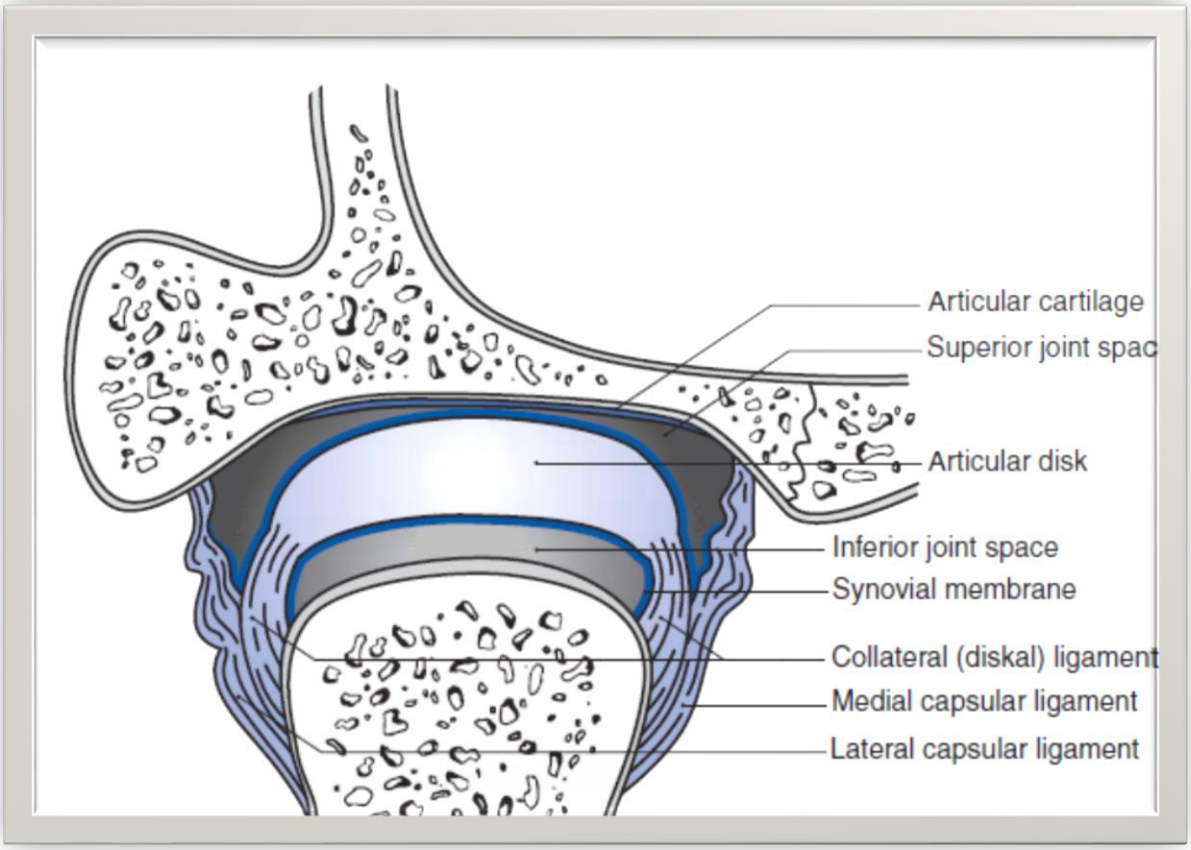


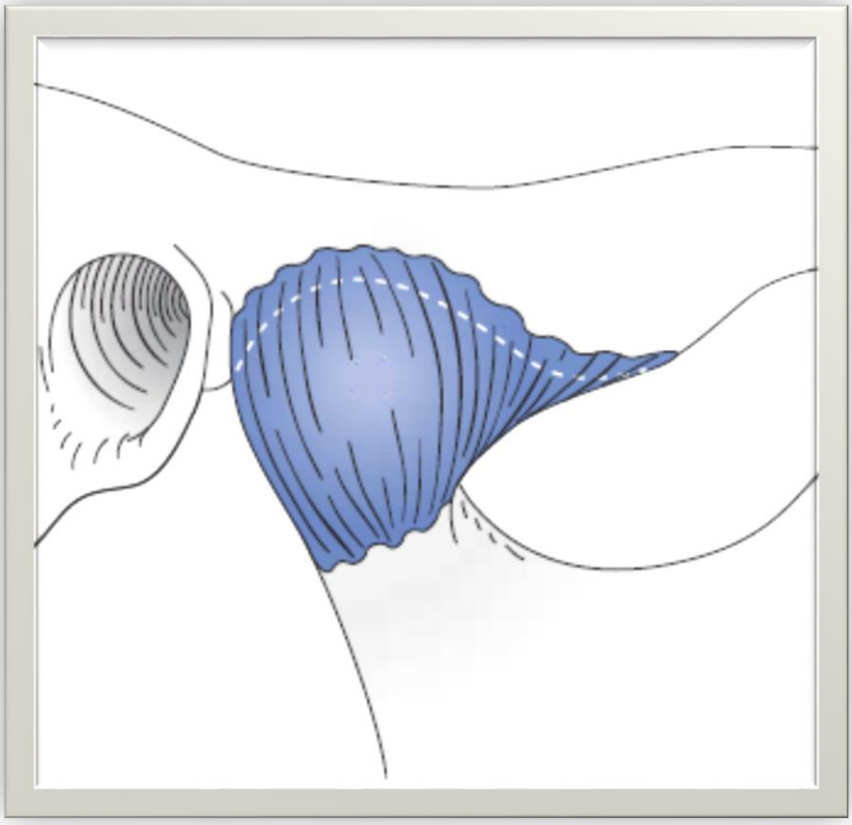
Biomechanics of Temporomandibular Joint Movement

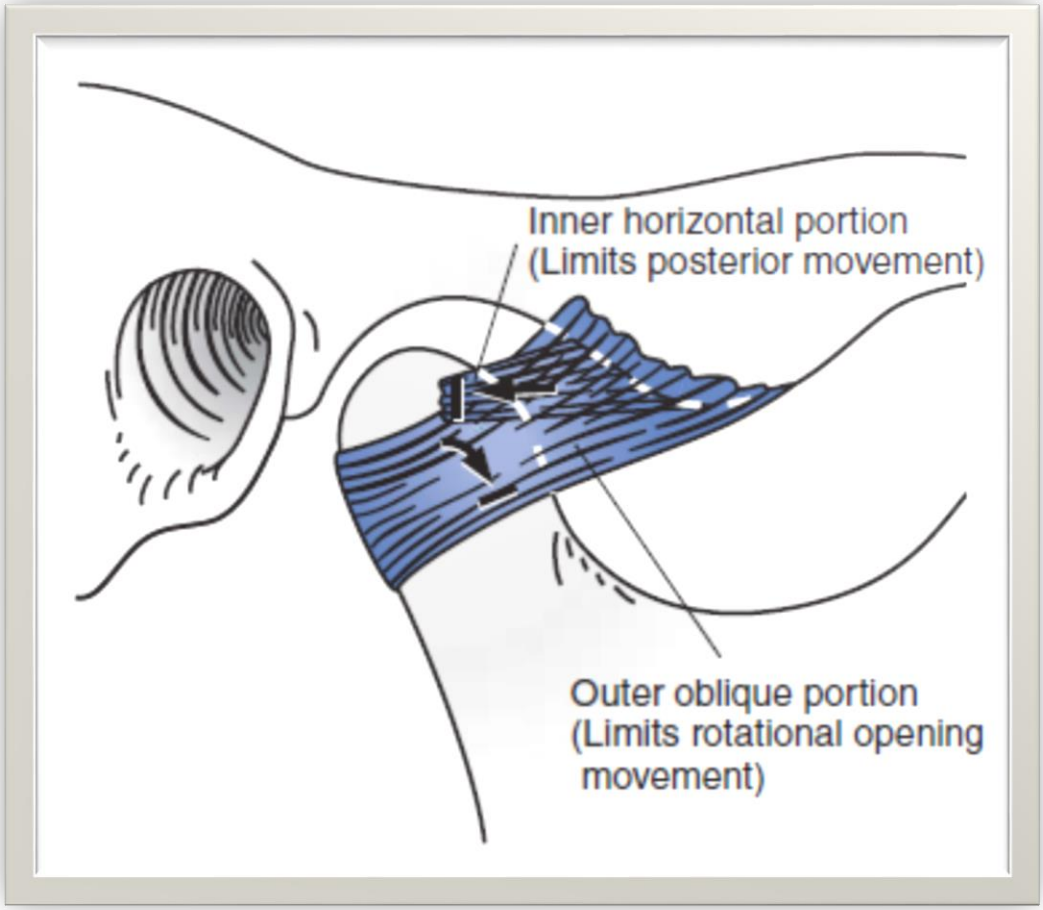
Two types of movement are possible in TMJ: **rotation and translation.**

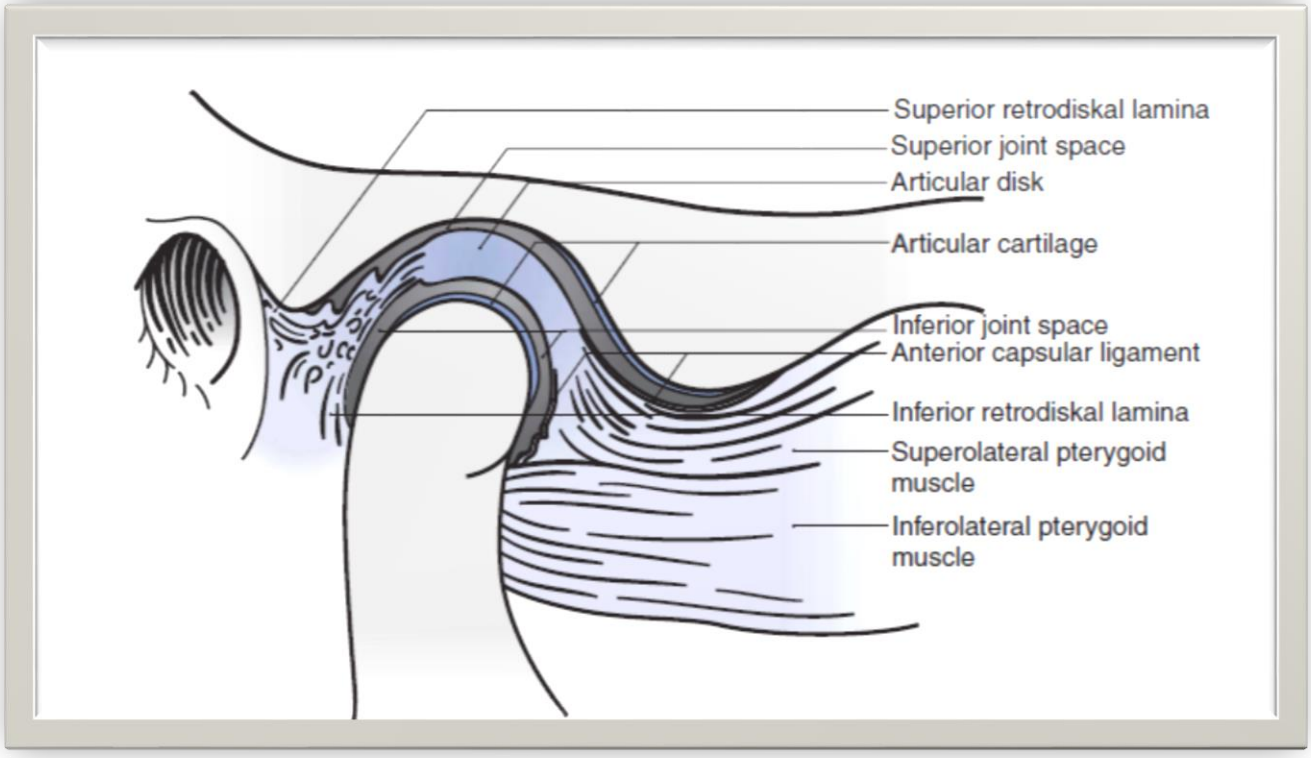
The inferior joints, consisting of the condyle and disk, are responsible for rotation, a hinge-like motion. The center of rotation is considered to be along a horizontal axis passing through both condyles. In theory pure hinge motion of approximately 2.5 cm measured at the incisal edges of the anterior teeth is possible. Nevertheless most mandibular movements are translatory as well, involving a gliding motion between the disk and the temporal fossa, which are the components of the superior joints. The mandible and disk glide together as a unit because they are held together by the collateral ligaments. The maximum forward and lateral movement of the upper joint in translation is approximately 1.5 cm.

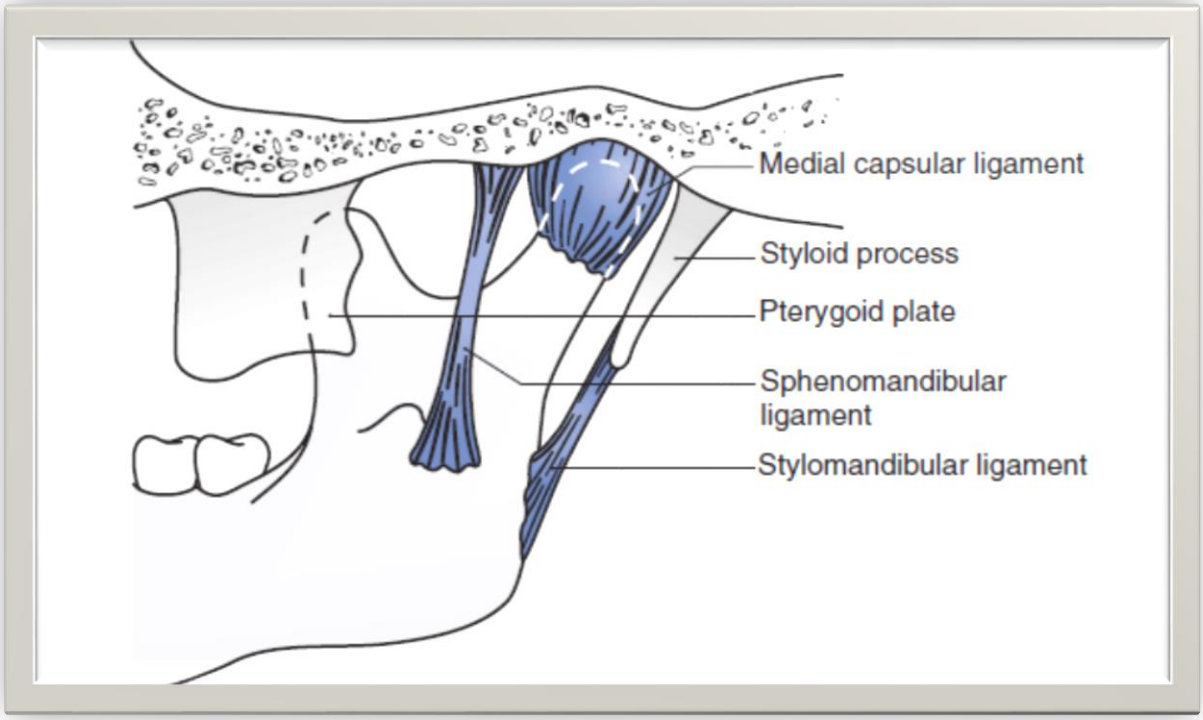
The ligaments associated with the TMJ do not move the joint. Although they can be lengthened by movements of muscles, they do not stretch (ie, do not have an elastic recoil that returns them to a resting position automatically). Instead the role of the ligaments is that of a passive restriction of movement at the extreme ranges of motion. During normal function rotational and translational movements occur simultaneously, permitting the free range of motion necessary in speaking and chewing.

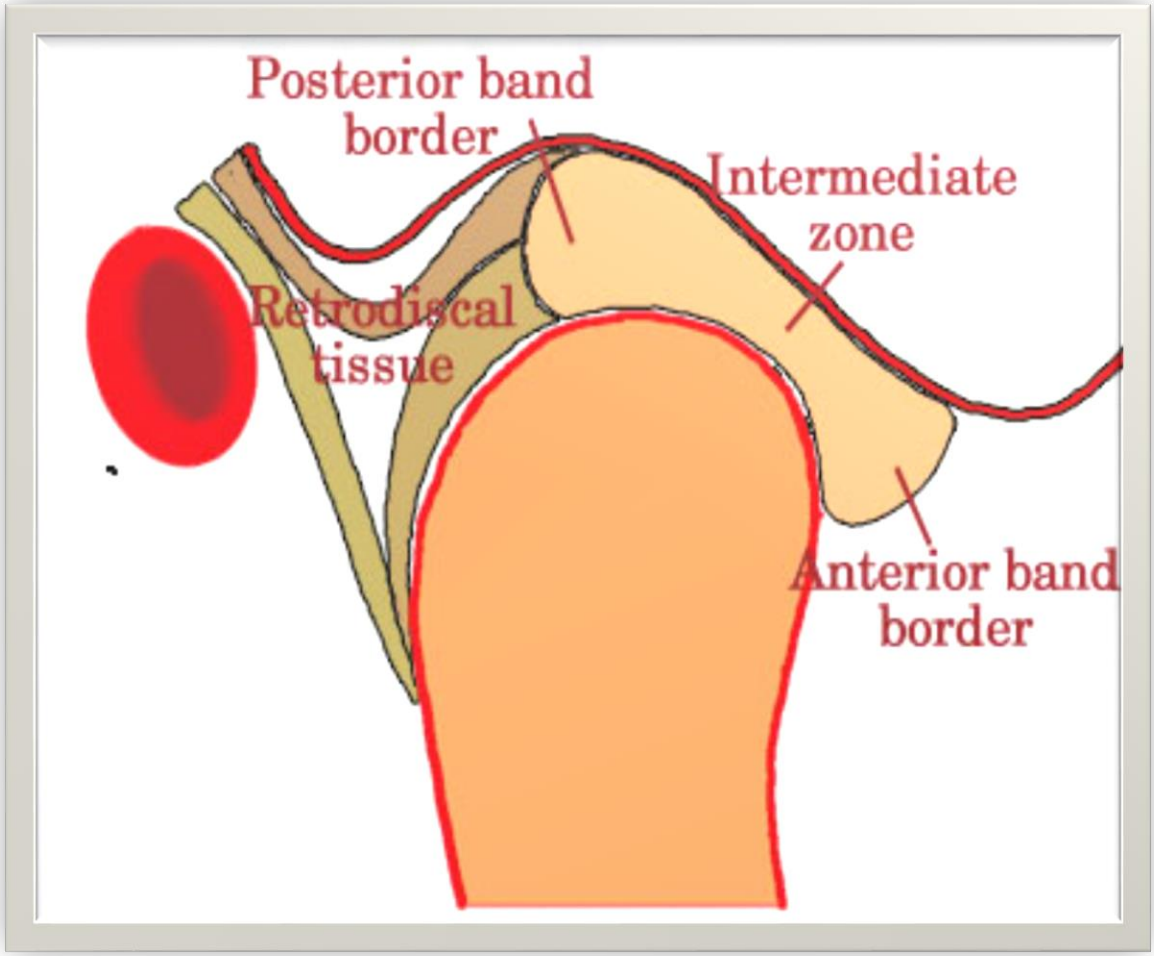

Articular cartilage
Superior joint spac
Articular disk
Inferior joint space
Synovial membrane
Collateral (diskal) ligament
Medial capsular ligament
Lateral capsular ligament




Inner horizontal portion
(Limits posterior movement)
Outer oblique portion
(Limits rotational opening
movement)


Superior retrodiskal lamina
Superior joint space
Articular disk
Articular cartilage
Inferior joint space
Anterior capsular ligament
Inferior retrodiskal lamina
Superolateral pterygoid
muscle
Inferolateral pterygoid
muscle


Medial capsular ligament
Styloid process
Pterygoid plate
Sphenomandibular ligament
Stylomandibular ligament


Posterior band border
Intermediate zone
Retrodiscal tissue
Anterior band border

sample question

Pain in the temporomandibular joint is transmitted by the

A. **auriculotemporal nerve in the articular surfaces of the mandible and temporal bones.**

B. **auriculotemporal nerve in the capsule and periphery of the disk.**

C. **maxillary branch of the trigeminal in the**