Types of Joints

• Fibrous
  – Two bones connected with fibrous tissue
  – Limited movement
  Examples
    - suture (little or no movement)
    - gomphosis (tooth - PDL - bone)
    - syndesmosis (fibula & tibia, radius and ulna; interosseous ligament)

• Cartilagenous
  – Little or no movement
  – Primary
    - Bone-Cartilage (costochondral junction)
  – Secondary
    - Bone-Cartilage-FT-Cartilage-Bone (pubic symphysis)

• Synovial
  – Two bones; each articular surface covered with hyaline cartilage in most cases
  – The bones are united with a capsule (joint cavity)
    - In the capsule there is presence of synovial fluid
  – The capsule is lined by a synovial membrane
    - In many synovial joints there maybe an articular disk
  – Synovial joints are characterized by the presence of ligaments
  – Movement affected by the muscles
  – Same innervation of muscle and joint
Synovial joints are classified according to the

- Number of axes of bone movement: uniaxial, biaxial, multiaxial
- Shapes of articulating surfaces: planar, ginglymoid (=hinged), pivot, condyloid

The temporomandibular joint is a synovial, sliding-ginglymoid joint (humans)
Embryology of the TMJ

- **Primary TMJ**: Meckel's cartilage --> malleus & incal cartilage. It lasts for 4 months
- **Secondary TMJ**: Starts developing around the third month of gestation
  Two blastemas (temporal and condylar); condylar grows toward the temporal
  (temporal appears and ossifies first)

Secondary TMJ

- Formation of two cavities: **inferior** and **upper**
- Appearance of disk
- Bones: glenoid fossa (temporal bone) and condyle (mandible)
- **ARTICULAR SURFACES COVERED BY FIBROUS TISSUE**
  - TMJ is an exception from other synovial joints
    - acromio- and sternoclavicular joints
Glenoid Fossa

- Medially is the sphenoid process
- Laterally is the zygomatic process
- Anteriorly is the articular eminence
- Posteriorly are the squamotympanic and petrotympanic fissures (temporal bone)

Histologic topography

- **Fibrous layer:** collagen type I, avascular (self-contained and replicating)
  - Lamina splendens
- **Proliferating zone** that forms condylar cartilage
- **Condylar cartilage** is fibrocartilage that does not play role in articulation, no formal function
  - Growth site
- **Capsule:** dense collagenous tissue (includes the articular eminence)
Condylar cartilage

- Absence of ordered cartilagenous cell columns
- Multidirectional proliferation

Histologic topography

- **Synovial membrane**: lines capsule (does not cover disk except posterior region); contains folds (increase in # in pathologic conditions) and villi.

  Two layers: a **cellular intima** (synovial cells in fiber-free matrix) and a **vascular subintima**

  Synovial cells
  - A (macrophage-like) Phagocytosis
  - B (fibroblast-like) add hyaluronate and other proteins in the fluid
Histologic topography

- Synovial fluid: plasma with mucin and proteins, cells
  Liquid environment: lubrication, nutrition
- **Disk**: separates the cavity into two compartments, type I collagen
  - anterior and posterior portions
  - anteriorly it divides into two lamellae one towards the capsule, the other towards the condyle
  - vascular in the periphery, avascular in the center

Histologic topography

- **Ligaments**: nonelastic collagenous structures. One ligament worth mentioning is the lateral or temporomandibular ligament. This restricts displacement of the mandible in three different planes
  - Lateral and medial dislocation
  - Inferior displacement (oblique component)
  - Posterior displacement (horizontal component)
- 2 other ligaments (no functional role)
Muscles

- Strap muscles
  - Fasciculi parallel

- Fusiform muscles
  - Bundles converge in the areas of origin and insertion

- Fan-shaped muscles

- Unipennate and bipennate muscles

Motor unit

- Innervation of muscles achieved through motor end plate
Two other neuronal structures for muscle contraction

1. Muscle spindle
   Encapsulated proprioreceptor
   Detects changes in length
   Intrafusal fibers

2. Golgi tendon organ
   Junction between muscle and tendons
   Smaller than spindles

Muscle Spindle
Intrafusal fibers assume two forms:
   a. Nuclear bag fiber
   b. Nuclear chain fiber

   Nuclear bag fiber innervated by primary afferent that spirals around the bag

   Nuclear chain fiber innervated by primary afferent in the central portion and a secondary terminal on either side

   Primary afferent: degree and rate of stretch
   Secondary terminal: only degree of stretch

Muscles of mastication

Function of muscles

- Mas., MedPter., antTemp, upper head of LatPter → closing
- Inferior head of LatPter., anterior belly digastric, mylohyoid → opening
- Inf head of LatPter and the elevator group → protrusion
- Posterior Temp and elevator group → retraction
- Elevator, post Temp → retraction working side
- Elevator, LatPter → protrusion non-working side
Innervation

<table>
<thead>
<tr>
<th>Type</th>
<th>Function</th>
<th>Sensation</th>
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<td>Ruffini</td>
<td>Posture</td>
<td>Dynamic and static balance</td>
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<tr>
<td>Pacini</td>
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<td>Movement accelerator</td>
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<tr>
<td>Free</td>
<td>Pain</td>
<td>Protection joint</td>
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</tbody>
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Blood supply

- External carotid
  - Superficial temporal
  - Anterior tympanic
  - Ascending pharyngeal
  - Deep auricular