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- **MUSCLE (GPT 8)**: An organ that by contraction produces movements of an animal; a tissue composed of contractile cells or fibres that effect movement of an organ or part of the body.

- **MASTICATION (GPT 8)**: the process of chewing food for swallowing and digestion.
INTRODUCTION

• Muscle refers to a group of muscle fibers bound together by connective tissue.

• Muscle generates force & movements used in the regulation of the internal environment.

• By controlling the activity of these muscles the human mind ultimately expresses itself.
DEVELOPMENT OF MUSCLES

- The muscular system develops from intra embryonic mesoderm
- Muscle tissues develop from embryonic cells called myoblast.
- Muscular component of Branchial arch form many striated muscles in the head and neck region.
- Muscles of mastication are derived from first or MANDIBULAR ARCH.
DEVELOPMENT OF MUSCLES
CLASSIFICATION OF MUSCLES

- Muscles of the body can be broadly classified based on structure, contractile properties, control mechanisms into
  - a) Skeletal muscle
  - b) Smooth muscle
  - c) Cardiac muscle
SKELETAL MUSCLE

• Constitutes about 40% of body mass. It is attached to the skeleton by tendons. The contraction of it is responsible for supporting & moving the skeleton.
• It is also called voluntary muscle because it contracts voluntarily when a signal is sent to it along the central nervous system.
• It is also called as striated muscle because the microscopic appearance shows cross striations. Most of the muscles of the orofacial region are skeletal muscles.
SMOOTH MUSCLE

• It is named so because it lacks the cross striated banding pattern found in skeletal muscle.
• It is also known as involuntary muscle because it is not under direct voluntary control instead they are controlled by the autonomic nervous system.
CARDIAC MUSCLE

• It is the muscle of the heart & it shows the features of both skeletal & smooth muscle.

• It shows the characteristic striated appearance of skeletal muscles & involuntary in action like the smooth muscle.

• contraction of the cardiac muscle propels the blood through the circulatory system
Units of skeletal muscle are the **muscle fibers**, each of which act as a single cell having hundreds of nuclei (syncytial striated myocytes).

Fibers are arranged in bundles of various sizes and pattern called **fasciculi**.
Connective tissue fills the spaces between muscle fibres within a fasciculus where it is known as the endomyscium.

Each fasciculus is also surrounded by a strong connective tissue sheath or perimyscium.

Surrounding the whole muscle lies epimyscium.
• Cell membrane of muscle fibre is known as **sarcolemma** while their cytoplasm is called **sarcoplasm**.

• Sarcoplasm is divided into longitudinal threads or **myofibrils** each of 1 micro meter in diam.

• Each muscle fiber consists of several hundred to several thousand **myofibrils**
CONTRACTION OF THE MUSCLE

• In the mid 1950s Jean Hauson and High Huxley had a revolutionary insight into the mechanism of muscle contraction.
• Previously scientists had imagined that muscle contraction must be a folding process.
• Hauson and Huxley proposed, however that skeletal muscle shortens during contraction because the thick and thin filaments slide past one another.
• Their model is known as sliding filament mechanism of muscle contractions.
SLIDING FILAMENT MECHANISM

• During muscle contraction, myosin heads pulls in the thin filaments, causing them to slide increased the H zone at the center of Sarcomere.

• The myosin cross bridges may even pull the thin filaments of each Sarcomere so far inward that their ends overlap in the centre of the Sarcomere.

• As the thin filament slide inward, the Z discs come toward each other, and the Sarcomere shortens but the lengths of thick and thin filaments do not change.
The sliding of the filaments and shortening of the Sarcomeres cause shortening of the whole muscle fiber and ultimately the entire muscle.
PROPERTIES OF SKELETAL MUSCLE

- **EXCITABILITY**: When a muscle is stimulated a number of electrical changes occur across the sarcolemma due to difference in the electrical potential. When stimulus of threshold potential is given these electrical changes lead to excitability of the muscle fiber.

- **CONTRACTION**: When a muscle is excited it responds by contraction. Contraction of muscle can either be isometric or isotonic.
• **ISOMETRIC CONTRACTION:** In this type of contraction, internal tension of muscle fibers becomes greater but the length of the muscle does not shorten.

• **ISOTONIC CONTRACTION:** In this type of contraction tension of the muscle remains same but length of the muscle shortens.
• Most of the contractions of the muscles are a combination of the two.

• **ALL OR NONE LAW:** It states that if a stimulus is applied, whatever may be the strength, the muscle responds to the maximum or it does not respond at all. Below the threshold level of strength of stimulus the muscle does not respond at all.
• **MUSCLE TONE:** When muscles are at rest, a certain amount of tonus usually remains. This residual degree of contraction in skeletal muscle is called muscle tone.

• **MUSCLE MEMORY:** When a muscle is contracted or stretched continuously muscle remains to be in same position even after relaxation. This is termed as muscle memory.
MUSCLES OF MASTICATION

• These are the muscles that move the mandible during mastication, speech & deglutition.

• They move the mandible quickly & precisely to enable different speech sounds that are to be made in rapid succession and they are also capable of exerting enormous forces that are required to break down tough foods.
PRIMARY MUSCLES OF MASTICATION

- MASSETER
- TEMPORALIS
- LATERAL PTERYGOID
- MEDIAL PTERYGOID
SECONDARY MUSCLES OF MASTICATION

- Suprahyoid muscles
- Infrahyoid muscles
SUPRAHYOID GROUP

• DIGASTRIC
• MYLOHTOID
• GENIOHYOID

• STYLOHYOID is another suprahyoid muscle which does not take part in mastication
INFRAHYOID MUSCLES
- STERNOHYOID
- THYROHYOID
- OMOHYOID

STERNOCLEIDOMASTOID AND TRAPEZIUS
• It is a quadrilateral muscle that covers most of the lateral aspect of the ramus. It consists of three layers which blend anteriorly.
**Superficial head:** It is the largest & arises by a thick aponeurosis from the maxillary process of zygomatic bone & from the anterior 2/3rd of the inferior border of the zygomatic arch. Fibers pass downwards & backwards at angle of 45 to insert into angle & lower posterior half of the lateral surface of the mandibular ramus.
**Middle head:** Arises from medial aspect of anterior 2/3rd of the zygomatic arch & from the lower border of the posterior 1/3rd of the zygomatic arch. Fibers pass vertically downward & insert into middle part of the ramus.

**Deep head:** Arises from the deep surface of the zygomatic arch. Fibers pass vertically downward and insert into superior border of the ramus as a triangular shaped insertion field.
• **Nerve supply:** It is supplied by massetric nerve a branch from anterior division of mandibular nerve.

• **Vascular supply:** It is supplied by a branch from second part of maxillary artery.
ACTIONS

• It is a powerful **elevator of the mandible** & is very active during forceful clenched (centric) occlusion.
• **Deep head** exerts primarily a vertical force on the mandible.
• **Superficial head** exerts vertical & anteriorly directed force.
• It also helps in **ipsilaterial excursion**. This is made possible by the fact that the origin of Masseter is slightly lateral to its insertion, therefore a contraction of Masseter on one side can move the mandible to that side.
SIGNIFICANCE IN PROSTHODONTICS

• When the Masseter is activated it pushes the Buccinator medially against the denture border in the area of retromolar pad
• This is a dislodging force and the denture base should be contoured to accommodate this action.
• This contour of the denture base is termed the massetric groove.
• At the Masseter groove impression will be reflected superiorly & medially forming a groove.
• If the distobuccal flange of denture base is not contoured to allow freedom for this action, the denture will be displaced.
• While checking for the tray extensions in mandible contraction of Buccinator & Masseter muscles almost completely obliterates the sulcus. So cut back the buccal periphery of the tray so that it is about 2mm short of the position occupied by buccal sulcus in function.

• Upper buccal vestibule which houses buccal flange of the denture is influenced by malar process, Buccinator, Masseter muscles.
• When the mandible is at rest it is supported by the elevator group of muscle fibers which are not fully relaxed but are in state of partial contraction or tonus which is sufficient to balance the tonus of the depressor muscles & gravity.
**MASSETRIC SILENT**: If a second stimulus is given before the muscle comes to a relaxed state, the muscle does not respond for the second stimulus of whatever strength it might be. This period of inactivity where the muscle does not respond is termed as massetric silent period.
• It is a fan shaped muscle that fills the temporal fossa. **Origin:** The periphery of the fan is attached to the inferior temporal line & handle of the fan is attached to the coronoid process below. It takes origin from the temporal fossa except the zygomatic bone & from the overlying temporal fascia.
**Insertion:** Its fibers converge to form a tendon that descends downward & pass through the gap between the side of the skull and zygomatic arch. They get inserted into apex, medial surface, anterior surface, posterior surface of the coronoid process. They also get inserted into anterior border of ramus.
**BLOOD SUPPLY**

- Deep temporal part of maxillary artery

- **Nerve supply**: It is supplied by deep temporal nerve which is a branch from anterior division of mandibular nerve.
ACTIONS

• **Elevates the mandible,** this movement requires both the upward pull of anterior fibers and backward pull of the posterior fibers.

• Posterior fibers draw the mandible backwards after it has been protuded.

• It is also a contributor to side to side grinding movement.
• It maintains normal mandibular rest position when the subject is in upright position. Posterior fibers lie in an almost horizontal plane & therefore are in a good position to pull the protruded mandible back to centric occlusion.

• It helps in ipsilateral excursion. This is made possible by the fact that the insertion of Temporalis is medial to the origin & therefore Temporalis acting singly is capable of pulling the mandible to the same or ipsilateral side.
SIGNIFICANCE IN PROSTHODONTICS:

• It acts as a **stabilizer of TMJ**. When the condyle is translated into a more protruded position these posterior fibers are aligned more horizontally.

• As its most posterior fibers pass very close to the condyle the posterior Temporalis functions as a stabilizer of TMJ.

• It suspends the mandible in centric relation. Anterior group of fibers which are aligned vertically **hold the mandible in superior most position**.

• Temporal headaches are common in TMD’s
LATERAL PTERYGOID

Lateral Pterygoid Muscle:
ORIGIN:
It is a short thick muscle with two parts or head

- **UPPER** head arise from infratemporal surface and infratemporal crest of greater wing of sphenoid bone
- **LOWER** head arise from lateral surface of lateral pterygoid plate.

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• **INSERTION:** Its fibers pass backwards and laterally to be inserted into a depression (pterygoid fovea) on the front of the neck of the mandible and into the articular capsule and disc of the temporomandibular articulation.
NERVE SUPPLY
• The lateral pterygoid is supplied by a branch of anterior division of the mandibular nerve

BLOOD SUPPLY
• Pterygoid branch of 2nd part of maxillary artery
ACTIONS OF INFERIOR HEADS

• Both the inferior pterygoids acting together are the prime protractors of the mandible. The fibers are in a perfect position to haul the condyles & articular disc forward in moving the mandible into a **protrusive position**.

• Inferior heads of both sides acting together **depress the mandible** by pulling forward the condylar process of the mandible & articular disc while the head of condyle rotates on the articular disc. It is also assisted by **suprahyoid & infrahyoid muscles** in performing these functions.

• Inferior head of each side acting singly brings about **contra lateral excursion**. This is made possible by the fact that its insertion is lateral to its origin.
ACTIONS OF SUPERIOR HEADS

• They are **inactive during opening**.

• They are active however during mandibular **elevation or closing along** with Temporalis, Masseter, Medial pterygoid.

• Superior heads are particularly active when the teeth, encounter resistance such as bolus of food. Closure on resistance is termed the **power stroke** & the superior lateral Pterygoids play an active role in power stroke.
SIGNIFICANCE IN PROSTHODONTICS

- During closure of the mouth the backward gliding of the articular disc & condyle is controlled by slow elongation of lateral pterygoid while Masseter & Temporalis restore the jaw to the occlusal position. Thus it acts as a stabilizer of TMJ.
- It holds the condyles in centric relation position.
MEDIAL PTERYGOID

Medial Pterygoid muscle
ORIGIN:

- It is a thick quadrilateral muscle
- Attached to medial surface of lateral pterygoid plate and grooved surface of pyramidal process of the palatine bone.
- A more superficial slip from the lateral surface of pyramidal process of the palatine bone and tuberosity of maxilla
**INSERTION:** Its fibers pass downwards laterally and backwards.

- Attached by a strong tendinous lamina, to the postero-inferior part of the medial surfaces of the ramus and the angle of the mandible.
- It is attached as high as mandibular foramen and as far forward as the mylohyoid groove.
NERVE SUPPLY
• Branch of the main trunk of the mandibular nerve.

BLOOD SUPPLY
• Pterygoid branch of 2nd part of maxillary artery
ACTIONS

• Assists in **elevating the mandible**
• Acting with the lateral pterygoid they protrude it
• Acting with medial pterygoid of same side advances the condyle, while the jaw rotates through the opposite condyle (when the medial and lateral pterygoid of the two sides contract alternatively to produce side to side movements of mandible eg chewing)
PALPATION OF MASTICATORY MUSCLES:

- An accepted method of determining muscle tenderness or pain is to use the finger tips of the middle & index finger to palpate specific anatomic sites. It has been proposed that 2 lb of digital pressure on extraoral muscles & 1 lb of pressure on intraoral areas held for 3 to 5 seconds are appropriate.
2. palpation

- check for tenderness
• **DIGASTRIC**

• The muscle has secondary role in mastication as a depressor muscle adding to the action of lateral pterygoid muscle when mouth is to be opened against resistance.

• Elevation of hyoidbone

•
**MYLOHYOID:**

- The secondary role of this muscle is evident as a depressor seen in action when mouth is to be opened against resistance.
- It elevates the floor of mouth to help in deglutition.
• GENIOHYOID:

• Geniohyoid elevates the hyoid bone and draws it forward, thus acting as a partial antagonist to stylohyoid.

• When the hyoid bone is fixed, it depresses the mandible.
• STERNOHYOID
• THYROHYOID
• OMOHYOID
• STERNOCLEIDOMASTOID

[Diagram showing the sternocleidomastoid muscle, clavicle, and manubrium of the sternum]
• TRAPEZIUS

THE TRAPEZIUS MUSCLE

upper fibers

middle fibers

lower fibers

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ROLE OF MUSCLES IN VARIOUS MANDIBULAR MOVEMENTS

• a) **ELEVATION:**
  Right & left Temporalis muscles (anterior fibres
  Right & left Masseter muscles
  Right & left Medial pterygoid muscle

• b) **DEPRESSION:**
  Right & left Inferior heads of Lateral pterygoids
  Right & left Suprahyoid and Infrahyoid muscles
  Anterior belly of Digastric & Mylohyoid
• c) PROTRUSION:
Right & left Inferior heads of Lateral pterygoid
Right & left Medial pterygoids
Right & left Superior heads of Masseter

• d) RETRUSION:
Right & left Posterior fibres of Temporalis
Right & left Deep heads of Masseter
• e) **RIGHT LATERAL EXCURSION**: Right Masseter, Right Temporalis, Left Medial pterygoid & Left Lateral pterygoid

• f) **LEFT LATERAL EXCURSION**: Left Masseter, Left Temporalis, Right Medial pterygoid & Right lateral pterygoid.
ROLE OF MASTICATORY MUSCLES IN VARIOUS PROSTHETIC PROCEDURES

- **BORDER MOULDING:** While checking for the tray extensions in the mandible contraction of Buccinator & Masseter almost completely obliterates the sulcus. So cut back the periphery of the tray so that it is about 2mm short of the position occupied by buccal sulcus in function.

- **FREEWAY SPACE:** When the mandible is at rest it is supported by the elevator group of muscles fibers which are not fully relaxed but are in a state of partial contraction or tonus which is sufficient to balance the tonus of the depressor muscles & gravity.
PATHOLOGY RELATED TO MUSCLES OF MASTICATION
• **MYOFASCIAL PAIN:** Most commonly reported type of masticatory muscle disorder. It is characterized by a dull regional ache that increases during function. Palpation reveals tenderness of these muscles.

• **MYOSITIS:** It is primary inflammation of muscle resulting from infection / trauma. It is characterized by constant acute pain in one or more of the masticatory muscles usually accompanied by swelling, redness of overlying skin & increase in temperature over the affected area. It results in jaw dysfunction & limited range of movement.
• **MYOSPASM / MUSCLE CRAMP:** Acute condition resulting from a sudden, involuntary & continuous tonic contraction of muscle. It is characterized by localized acute pain & severely limited range of motion of the mandible. These characteristics coupled with their sudden onset at rest allow the clinician to differentiate myospasm from other masticatory muscle disorders.

• **LOCAL MYALGIA:** It refers to a general category of acute muscle pain disorders whose etiology & pathology cannot currently be explained.
• **MYOFIBROTIC CONTRACTURE:** It involves a painless shortening of muscle as a result of fibrosis in & around the remaining contractile muscle tissue. It follows an infectious process or trauma. There is limited mouth opening & unyielding resistance to passive jaw muscle stretch.
MODIOLUS: (in Latin “hub of a wheel)

- It is a fibro muscular mass formed by the convergence of various muscles towards a focus just lateral to the buccal angle.

- It can be palpated most effectively by using the opposed thumb & index finger to compress the mucosa & skin simultaneously.

- It is formed by nine muscles. They are divided into two groups.
• **Cruciate modiolar muscles:** Zygomaticus major, Levator anguli oris, Depressor anguli oris, Platysma pars modiolaris.

• **Transverse muscles:** Buccinator, Risorius, Orbicularis oris, Incisivus superior & inferior.
• **Action:** The contraction of modiolus presses the corner of the mouth against the premolars so that the occlusal table is closed in front. Food is crushed by the premolars & molars and it does not escape at the corner of mouth unless seventh nerve damage (Bell’s palsy) has occurred.
Prosthetic significance:

• BORDER MOULDING: The functional movements are made during the border moulding procedure by holding the modiolus with thumb and index finger.

• It helps in establishing the height of occlusal plane of maxillary occlusal rim. Corners of the mouth are marked on the occlusal rims to provide the dentist & technician with anterior landmarks for the height of first premolars.
It is a potential denture space where the forces of the tongue musculature pressing outward are neutralized by forces of the muscles of the cheeks and lips pressing inward.
• **PROSTHETIC SIGNIFICANCE:** Neutral zone should be recorded clinically & teeth arrangement should be done in the neutral zone. This contributes to the stability of the denture.
CONCLUSION

• The masticatory system is extremely complex, primarily made of bones, muscles, ligaments and teeth.

• Precise movement of mandible by the musculature is required to move the teeth effectively across each other during function.

• The knowledge of the anatomy physiology and mechanisms of these muscles are basic to understand the movements.
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THANK YOU