Muscles of Mastication and of the Tongue

Whether it is grinding food, chewing bubble gum, or moistening the lips with the tongue - we consciously and unconsciously use our jaw and tongue muscles every day. In this section you will find a compact overview of the properties of the tongue and the hyoid muscles as well as the functions, origins, and insertions of the four chewing muscles and the special features of the temporomandibular joint.

Tongue and Hyoid Muscles
Muscles of the human tongue

The tongue muscles consist of

- intrinsic tongue muscles and
- extrinsic tongue muscles

**Intrinsic tongue muscles**

The intrinsic tongue muscles alter the shape of the tongue and are innervated by the **hypoglossal nerve**—cranial nerve XII. Their effect depends on the simultaneous contraction of other intrinsic tongue muscles.

The tissue pressure that arises during contraction of the intrinsic tongue muscles works in an antagonistic manner similar to a water cushion.

The intrinsic tongue muscles consist of the following muscles:

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior longitudinal</td>
<td>The <strong>superior longitudinal muscle</strong> originates from the <strong>tip of the tongue</strong> and inserts at the <strong>root of the tongue</strong>. It can shorten and widen the tongue and elevate the tip of the tongue.</td>
</tr>
<tr>
<td>Inferior longitudinal</td>
<td>The <strong>inferior longitudinal muscle</strong> shortens and widens the tongue and depresses the tip of the tongue. The origin and insertion are the same as for the <strong>superior longitudinal muscle</strong>.</td>
</tr>
<tr>
<td>Transverse</td>
<td>The origin and insertion of the <strong>transverse muscle of the tongue</strong> form the lateral edges of the tongue. It is responsible for narrowing and extending the tongue as well as arching the lateral edges of the tongue in an upward direction.</td>
</tr>
<tr>
<td>Vertical</td>
<td>The task of the <strong>vertical muscle of the tongue</strong> is to flatten, widen, and lower the tongue. It originates from the <strong>lingual aponeurosis</strong> and inserts at the lower surface of the tongue.</td>
</tr>
</tbody>
</table>

It can be difficult for some patients to perform certain movements 'on command'. Various movements of the tongue can be observed during the examination of the patient.
Note: If there is a lesion of the hypoglossal nerve, the tip of the tongue deviates to the diseased side.

Extrinsic tongue muscles

The task of extrinsic tongue muscles is the movement of the whole tongue in the oral cavity. Depending on the location of the muscle, the tongue can be moved forward and backward and can also be elevated and depressed.

There are 5 extrinsic tongue muscles:

<table>
<thead>
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<tr>
<td>Genioglossus muscle</td>
<td>The genioglossus originates from the inner surface of the mandible and inserts at the lingual aponeurosis. The muscle pulls the tongue forward and downward. Like all the other extrinsic tongue muscles, it also moves the whole tongue in the oral cavity or even out of the cavity if the intrinsic tongue muscles simultaneously perform a longitudinal extension.</td>
</tr>
<tr>
<td>Hyoglossus muscle</td>
<td>The hyoglossus has its origin at the major horn and the body of the hyoid bone and pulls the tongue base backward and downward, which moves food components towards the esophagus. This function immediately follows the initiation of the swallowing process by the styloglossus. The hyoglossus also inserts at the lingual aponeurosis, but on the lateral side.</td>
</tr>
<tr>
<td>Chondroglossus muscle</td>
<td>The chondroglossus originates from the minor horn of the hyoid bone and runs to the lingual aponeurosis. In terms of its effect, it corresponds to that of the hyoglossus.</td>
</tr>
<tr>
<td>Styloglossus muscle</td>
<td>The main task of the styloglossus is to pull the tongue base backward and upward. As mentioned earlier, its contraction initiates swallowing after chewing. The food is pushed against the palate so that the swallowing reflex is triggered. The muscle is also important for sucking motions: during sucking, the tongue is pulled back in the oral cavity like the piston of a syringe. It originates from the styloid process and inserts at the lateral edge of the tongue.</td>
</tr>
<tr>
<td>Palatoglossus muscle</td>
<td>The palatoglossus elevates the tongue during swallowing. It originates from the palatine aponeurosis and radiates into the intrinsic tongue muscles.</td>
</tr>
</tbody>
</table>

Like the intrinsic tongue muscles, the genioglossus, hyoglossus, chondroglossus, and styloglossus muscles are innervated by the hypoglossal nerve. The palatoglossus muscle is however supplied by the glossopharyngeal nerve (IX) and vagus nerve.

Muscles of the lingual bone

The lingual bone (Latin: os hyoideum, hyoid bone) serves as a support for the base of the tongue and is a hoof-shaped flat bone-brace. It is possible to feel it in the kink between the neck and the floor of the mouth. The hyoid bone can easily be moved back and forth since it rises and lowers every time a person swallows.

Hyoid bone mobility

The hyoid bone is very mobile since it does not have any direct contact with other bones. It inserts between the hyoid muscles like a bony intermediate tendon and is, additionally, fixed to the skull by ligaments.

Originating from the head, the suprahyoid muscles insert at the hyoid bone and the infrahyoid muscles originate or insert into the hyoid bone.

Suprahyoid muscles
The following muscles are part of the suprahyoid muscles:

- digastric muscle
- mylohyoid muscle
- stylohyoid muscle
- geniohyoid muscle

The floor of the mouth extends – in the form of a muscle plate – from the hyoid bone to the inner surface of the mandible. The left and right floor of mouth muscles (mylohyoid) are united via an intermediate tendon.

The digastric has 2 bellies and lies on the outside of the mouth floor. It is connected to the hyoid bone by an intermediate tendon. The anterior belly runs upwards obliquely and on to the inner surface of the chin. The posterior belly runs upwards obliquely and backward to the base of the skull.

Parallel to the posterior belly, the stylohyoid also runs from the styloid process at the base of the skull to the hyoid bone.

Lying next to the median plane and running from front to back, the right and left geniohyoid muscles lie close together at the superior surface of the mouth floor. This is also referred to as the chin-hyoid bone muscle.

Infrahyoid muscles

The following muscles are assigned to the infrahyoid group of muscles:
omohyoid muscle
sternohyoid muscle
sternothyroid muscle
thyrohyoid muscle

From the hyoid bone to the posterior surface of the manubrium, the infrahyoid muscles extend in the form of a straight strand on both sides of the midline.

The only exception is the omohyoid (scapula-hyoid bone-muscle), which runs to the superior margin of the scapula under the sternocleidomastoid in the lateral cervical triangle. During powerful actions, it appears temporarily as an oblique strand in the lateral cervical triangle.

Each of the other 3 muscles consists of 3 plates of strap-shaped muscles. The sternohyoid is the longest of them. Together, the sternothyroid and thyrohyoid muscles form a consecutive muscle loop, which is as long as the sternohyoid.

Functions of the Hyoid Muscles

During swallowing, the suprahyoid muscles pull the larynx, which is connected to the hyoid bone, against the posterior end of the tongue until the flexible epiglottis abuts, bends, and lies protectively over the entrance to the larynx. This is required to avoid anything being taken into the trachea. The larynx and the hyoid bone are then led back to their original position by the infrahyoid muscles.

As a connecting, free bone, the hyoid bone is inserted into a muscular loop, which consists of the suprahyoid and infrahyoid muscles. They form a synergistic muscular loop so that the hyoid bone can be fixed at the fixed point by means of counter-resistance. This is implemented when the mouth is opened against resistance.

As the hyoid muscles keep the hyoid bone in position, the originating tongue muscles have a fixed point for the purpose of tongue movement.

During flexion of the cervical spine and the head, the hyoid muscles may contribute. If needed, the muscular loop of the tongue muscles can be used as respiratory muscles, which pull the sternum cranially.

**Note:** The hyoid muscles fulfill the following tasks:

- Participation in the act of swallowing
- Directing the movement of the mandible
- Indirect participation in tongue movement
- Opening the mouth against resistance
- Participation in the flexion of the cervical spine and the head
- Respiratory muscles
- By means of the omohyoid: keeping the major jugular vein open against the negative pressure produced by the heart, which is a suction pump.

Muscles of Mastication and Temperomandibular Joint

The masseter muscle is located in the posterior parts of the cheek and it covers the ascending ramus of the mandible as well as the mandibular angle from the outer
surface. Along with the temporal muscle and the medial and lateral pterygoid muscles, it is a member of the chewing muscles that are grouped together not only functionally, but also in evolutionary terms. They are innervated by the mandibular branch of the trigeminal nerve (V).

Temporal muscle

![Location of the temporal muscle. By: Was a bee. License: CC BY-SA 2.1 JP](image)

It is often difficult to discuss the temporal muscle without considering their main synergists—the masseter and medial pterygoid.

The temporal muscle expands across the major part of the lateral wall of the skull. Its posterior and superior borders are marked by the inferior temporal line. The muscle reaches its greatest thickness behind the zygomatic bone. In a horizontal section, the muscle would look like a triangle extending over the cheekbone. At the front, a wide base would be seen and at the back, a long tip which peters out would be seen.

The temporal muscle originates from the temporal fossa and is covered by 2 layers of fasciae. The superficial fascia consists of a loose layer of connective tissue. Beyond the temporal plane, it grows firm against the periosteum. However, the deep temporal fascia has an aponeurosis character and also expands over the temporal muscle.

The muscle is shaped like a fan in which the anterior and deep fibers run almost vertically, or, rather, medially from the front in lateral and posterior directions. The posterior fibers run in a horizontal direction. The muscle fibers bunch into a tendon during their course, and this tendon inserts at the coronoid process of the mandible.

Functions of the Temporal Muscle

The temporal muscle facilitates powerful biting and it can simultaneously also pull the mandible backward by means of its horizontal fibers.

Depression of the mandible due to gravity is inhibited by its continuous tone.

**Note:** The temporal muscle is often involved in the development of a tension headache
Masseter muscle

The shape of the masseter is often compared to a rectangle with a rounded bottom corner.

Superficially, the muscle is divided into 2 portions. The larger, rectangular, anterior part of the masseter muscle that runs obliquely (the superficial part) originates from the zygomatic process of the maxilla and from the anterior two-thirds and inferior surface of the zygomatic arch. The deep part of the masseter muscle originates from the posterior two-thirds, inferior surface, and the medial surface of the zygomatic arch.

The superficial part of the masseter extends to the mandibular angle and the masseteric tuberosity, as for the deep part, it extends to the outer surface of the mandibular ramus.

Functions of the masseter muscle

The masseter facilitates the powerful closing of the jaw. It can also move the mandible forward by means of its superficial part and backward with its deep part.

The medial pterygoid assists during this movement.

Note: In case of paralysis of the masseter, the function of this muscle can be performed by the medial pterygoid and temporal muscles.

Spastic reaction pattern can result from a skull/brain trauma, with another consequence being that it becomes more difficult to open the mouth; it also leads to severe teeth grinding (bruxism).

Medial pterygoid muscle
The **medial pterygoid** lies at the medial side of the mandible in the form of a mirror image of the **masseter**.

It originates from the pterygoid fossa of the sphenoid bone and from the **lateral lamina** of the **pterygoid process** and runs back to the inner surface of the **mandibular angle** and the **pterygoid tuberosity**.

It is significantly narrower than the masseter and is shaped like a narrow rectangle.

**Function of the medial pterygoid**

The **medial pterygoid** closes the jaw in a powerful manner. It is able to pull the mandible slightly forwards and sideways.

**Lateral pterygoid muscle**

The **lateral pterygoid** expands at the **infratemporal fossa**. The course of the horizontally running fibers significantly differs from the course of the other jaw adductors.

The upper part of the **lateral pterygoid** originates from the **temporal surface** of the **major wing of the sphenoid bone**, and the lower part originates from the lateral surface of the **lateral lamina** of the **pterygoid process**. The upper part inserts at the **pterygoid fovea** of the **condylar process** and at the anterior margin of the **articular disc** of the temporomandibular joint. The insertion of the lower part of the **lateral pterygoid muscle** is the **pterygoid fovea** of the **condylar process**.

**Functions of the lateral pterygoid muscle**

The **lateral pterygoid** is an important opener of the jaw. Extending from the front, it inserts at the mandible and can pull the mandible itself and the disc of the temporomandibular joint forwards.

In summary, one should know the following functions of the muscles of mastication:

**Masseter:**
- Elevation of the mandible
- Protrusion of the mandible
- Slight lateral sideways movement of the mandible during unilateral contraction

**Temporal muscle:**
- Elevation of the mandible
- Retraction of the mandible
- Slight protrusion of the mandible
- Slight lateral sideways movement of the mandible during unilateral contraction

Medial pterygoid:
- Elevation of the mandible
- Protrusion of the mandible
- Medial sideways movement of the mandible during unilateral contraction

Lateral pterygoid:
- Protrusion of the mandible
- Depression of the mandible
- Medial sideways movement of the mandible during unilateral contraction

**Temporomandibular Joint**

The temporomandibular joint is one of the ‘connected flexible’ bone joints and it represents a closed sequence of joints.

The **condylar process** of the mandible and the **mandibular fossa** of the temporal bone form the temporomandibular joint.

Anteriorly, the mandibular fossa is bordered and stiffened by the **articular tubercle** and, posteriorly, by the retroarticular process, which is small in humans. It is only covered by fibrocartilage at the front.

The shape of the **condyle of the mandible** fits the articular fossa and has an ellipsoid form, which is somewhat broader laterally than medially. Furthermore, its upper anterior articular surface is more inclined to the outside and is covered with fibrocartilage. The dorsal articular surface descends to the posterior in a flattened manner and it is only covered by dense connective tissue.

The **articular disc** separates the head and socket from each other so that 2 completely separate articular cavities exist. The disc is a trapezoid body, which is thickened at both its longitudinal sides and whose middle narrow zone is very thin. In the inferior articular cavity, the articular head of the jaw around a frontal or vertical axis (rotation), while a sliding movement occurs between the disc and the mandibular fossa in the superior articular cavity.
Movement of the temporomandibular joint

Due to the type of movement that is characteristic of the temporomandibular joint, it is referred to as a mixed joint, with 4 degrees of movement.

The main movements are classified as follows:

- hinge-like elevation and lowering of the mandible around a horizontal axis
- grinding movements – i.e. rotation of the mandible around a vertical axis
- protrusion and retraction along a sagittal axis

**Note:** Lockjaw occurs if the head of the mandibular joint moves in front of the articular tubercle when the mouth is wide open, such that it is caught in this position so that the mouth is no longer able to close.

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