

MANAGEMENT OF ODONTOGENIC INFECTIONS

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Fascial Space Infection

Fascial spaces are fascia-lined tissue compartments, filled with loose, areolar connective tissue (serves to cushion the muscles, vessels, nerves, glands, and other structures that it surrounds and to allow relative movement between these structures). They are potential spaces that can become inflamed when invaded by microorganisms.

During an infection, this cushioning and lubricating tissue has the potential to become greatly edematous in response to the exudation of tissue fluid and then to become indurated when polymorphonuclear leukocytes, lymphocytes, and macrophages migrate from the vascular space into the infected interstitial spaces. Ultimately, liquefactive necrosis of white blood cells and this connective tissue leads to abscess formation, and spontaneous or surgical drainage typically leads to resolution.

Based on the relationship between the point at which the infection erodes through alveolar bone and surrounding muscle attachments, infections arising from any maxillary or mandibular tooth can cause primary or secondary space infections.

Classification of Fascial Spaces:

Based on mode of involvement, facial spaces divided into:

Primary spaces (spread of infection directly from the oral cavity):

- **Primary maxillary:** Labial vestibular, Infratorbital (canine), Buccal, Infratemporal.
- **Primary mandibular:** Buccal, Perimandibular (submental, sublingual, and submandibular).

Secondary spaces (spread of infection from the primary spaces):

- **Secondary maxillary:** Periorbital and orbital spaces, Cavernous sinus.
- **Secondary mandibular:** Masticator spaces (submasseteric, pterygomandibular, superficial & deep temporal), Deep cervical fascial spaces (Lateral pharyngeal, Retropharyngeal, Parotid, Prevertebral).

Primary maxillary spaces

1. Labial vestibular space:

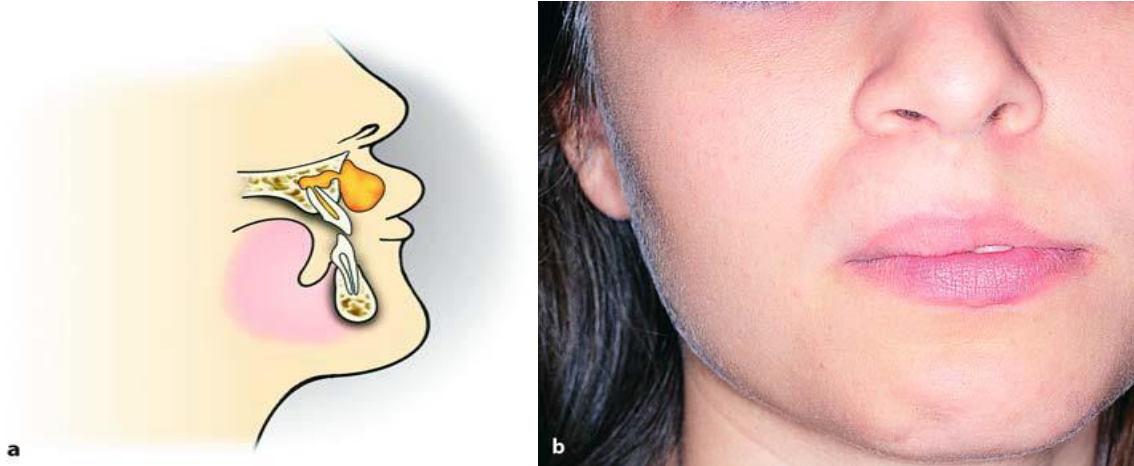
Location: Between the vestibular mucosa and the muscles of facial expression.

Etiology: Maxillary central and canine usually have their roots in close approximation to the buccal cortex of the bone.

Connections: Canine and Buccal spaces.

Signs and symptoms: Vestibular fluctuation and swelling.

Surgical approach: Vestibular incision.



(Labial vestibular space infection)

2. *Infraorbital or Canine space:*

Location: Between the levator anguli oris and the levator labii superioris muscles.

Content: Angular artery and vein, infraorbital nerve

Etiology: Maxillary canine (The canine root is often sufficiently long to allow erosion to occur through the alveolar bone that is superior to the origin of the levator anguli oris and below the origin of the levator labii superioris muscle).

Connections: Vestibular and Buccal spaces.

Signs and symptoms: Edema spreads towards the medial canthus of the eye, lower eyelid, and side of the nose as far as the corner of the mouth. There is also obliteration of the nasolabial fold, and somewhat of the mucolabial fold. spontaneous drainage of infections of this space commonly occurs near the medial or the lateral canthus of the eye because the path of least resistance is to either side of the levator labii superioris muscle, which attaches along the center of the inferior orbital rim.

Surgical approach: Vestibular incision.



(Infraorbital or Canine space infection)

3. *Buccal space:*

Location/ boundaries: The overlying skin of the face on the lateral aspect, the buccinator muscle on the medial aspect, the zygomatic arch from the superior aspect and the lower border of the mandible from the inferior aspect.

Content: Parotid duct, anterior facial artery and vein, transverse facial artery and vein, buccal fat pad.

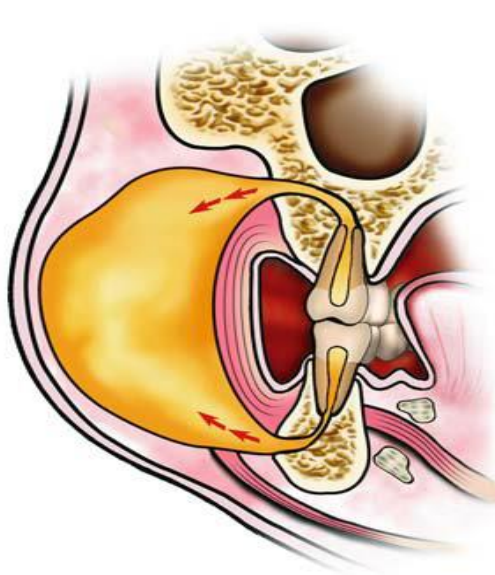
Etiology: Infection from maxillary teeth through the bone superior to the attachment of the buccinator on the alveolar process of the maxilla. Posterior maxillary teeth (most commonly molars and rarely premolars) cause most buccal space infections.

Connections: Vestibular space, Infraorbital (canine) space, Periorbital space, Superficial temporal space, Infratemporal space, Pterygomandibular space.

Signs and symptoms: Swelling below the zygomatic arch and above the inferior border of the mandible.

Surgical approach: Access to the buccal space is usually intraoral (vestibular incision) for three main reasons: the abscess fluctuates intraorally in the majority of cases, avoid injuring the facial nerve, for esthetic reasons.

An extraoral incision (submandibular incision: approximately 1-2 cm below and parallel to the inferior border of the mandible) is made when intraoral access would not ensure adequate drainage, or when the pus is deep inside the space.



(Buccal space infection)

4. *Infratemporal space:*

Location/ boundaries: Lies posterior to the maxilla, bounded medially by the lateral pterygoid plate of the sphenoid bone and superiorly by the base of the skull. Laterally, the infratemporal space is continuous with the deep temporal space.

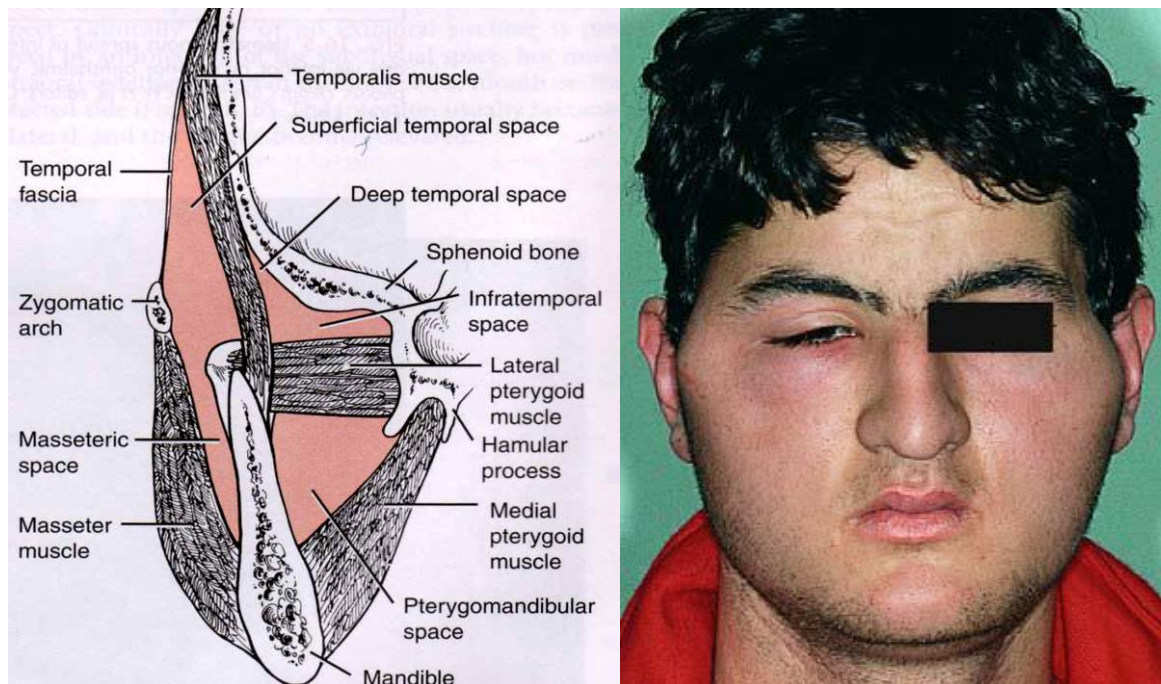
Content: Branches of the internal maxillary artery and the pterygoid venous plexus.

Etiology: The infratemporal space is rarely infected, but when it is, the cause is usually an infection of the maxillary third molar. Also infection may spread from the pterygomandibular space.

Connections: Deep temporal, Pterygomandibular, Buccal and Orbital spaces.

Signs and symptoms: Trismus and pain during opening of the mouth with lateral deviation towards the affected side, edema at the region anterior to the ear, which extends above the zygomatic arch, as well as edema of the eyelids.

Surgical approach: Intraoral (vestibular incision) or Extraoral (The incision is performed on the skin in a superior direction, and extends approximately 3 cm, starting from the angle created by the junction of the frontal and temporal processes of the zygomatic bone).



(Infratemporal space infection)

Secondary maxillary spaces

1. *Periorbital or Orbital cellulitis:*

Periorbital cellulitis is an infection of the eyelid and the periorbital soft tissues; orbital cellulitis is an infection of the eyeball and tissues around it. Rarely occurs as the result of odontogenic infection.

The presentation is typical: redness and swelling of the eyelids and involvement of the vascular and neural components of the orbit. This is a serious infection and requires aggressive medical and surgical intervention from an oral-maxillofacial surgeon and sometimes from other specialists.



(Periorbital cellulitis)

(Orbital cellulitis)

2. *Cavernous sinus thrombosis:*

A serious, life-threatening infection that requires aggressive medical and surgical care and has a high mortality even today. Intravascular inflammation caused by the invading bacteria stimulates the clotting pathways, lead to the formation of thrombus in the cavernous sinus and communicating branches. Cavernous sinus thrombosis rarely occurs due to an infected tooth.

Spread of infection: Because the veins of the face and the orbit do not have valves, blood-borne infections may pass superiorly or inferiorly along their course reaching dangerous structures such as cavernous sinus.

The anterior route to the cavernous sinus:

Infections erode into superior or inferior ophthalmic vein through the superior orbital fissure and extend directly into the cavernous sinus.

The posterior route to the cavernous sinus:

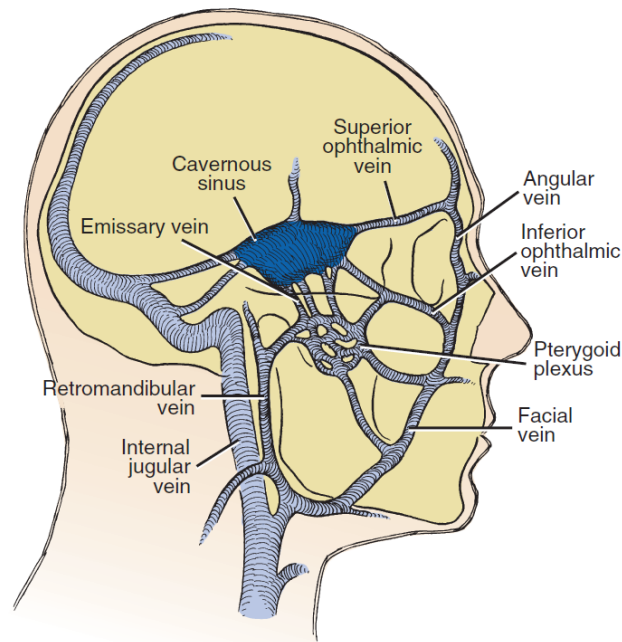
The emissary veins from the pterygoid plexus pass through foramina in the base of the skull and reach the cavernous sinus.

Content: the cranial nerves Oculomotor III, Trochlear IV, ophthalmic maxillary branches of the trigeminal nerves V1, and Abducens VI, which, accompanied by the horizontal segment of the internal carotid artery.

Symptoms of the eyes include periorbital swelling and redness, ptosis, proptosis, chemosis, external ophthalmoplegia and decreased visual acuity. The symptoms start in one eye then spread to the other eye within 24-48 hrs.

Other symptoms: fever, headache, seizures.

Complications: meningitis, sepsis



(Hematogenous spread of infection from the jaw to the cavernous sinus)

Primary mandibular spaces

1. Buccal space:

Location/ boundaries: The overlying skin of the face on the lateral aspect, the buccinator muscle on the medial aspect, the zygomatic arch from the superior aspect and the lower border of the mandible from the inferior aspect.

Content: Parotid duct, anterior facial artery and vein, transverse facial artery and vein, buccal fat pad.

Etiology: Infection arising from a mandibular posterior tooth perforates the buccal cortical bone and the periosteum inferior to the attachment of the buccinator muscle.

Connections: Vestibular space, Infraorbital (canine) space, Periorbital space Superficial temporal space, Infratemporal space, Pterygomandibular space.

Signs and symptoms: Swelling below the zygomatic arch and above the inferior border of the mandible.

Surgical approach: intraoral and extraoral approaches (discussed with the maxillary spaces).

2. *Perimandibular spaces: (submental, sublingual, and submandibular spaces):*

a) **Submental space:**

Location: Laterally and on both sides by the anterior belly of the digastric muscle, the mylohyoid muscle superiorly and the overlying fascia inferiorly.

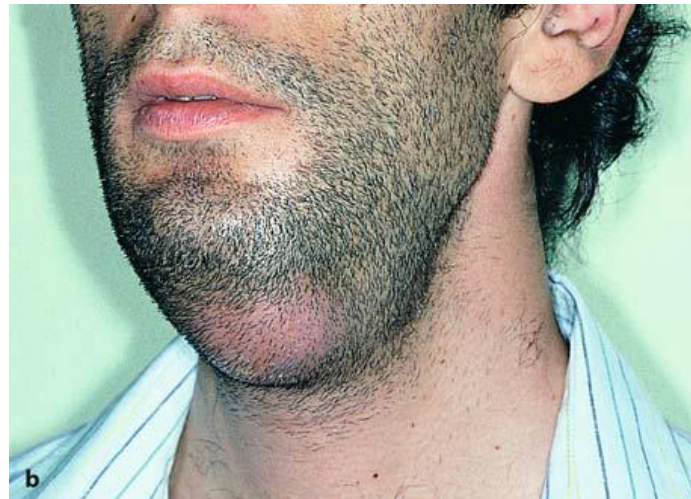
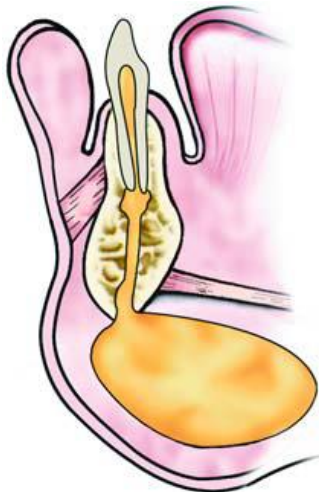
Content: Anterior jugular vein and the submental lymph nodes.

Etiology: Isolated submental space infections are rare, caused by infections of the mandibular incisors. Also, spread of infection from submandibular space, which can easily pass around the anterior belly of the digastric muscle and enter the submental space.

Connections: Submandibular space.

Signs and symptoms: Indurated and painful submental edema, which later may fluctuate.

Surgical approach: Extraoral approach (incision on the skin, beneath the chin, in a horizontal direction and parallel to the anterior border of the chin).



(Submental space infection)

b) **Sublingual space:**

Location: Between the oral mucosa of the floor of the mouth superiorly and the mylohyoid muscle inferiorly. Anteriorly and laterally by the inner surface of the body of the mandible and medially by the midline genioglossus/geniohyoid muscle complex. The posterior border of the sublingual space is open, and therefore, it freely communicates with the submandibular space.

Content: Submandibular duct (Wharton's duct), the sublingual gland, the sublingual and lingual nerve, terminal branches of the lingual artery, and part of the submandibular gland.

Etiology: The factor that determines whether the infection is submandibular or sublingual is the attachment of the mylohyoid muscle on the mylohyoid ridge of the medial aspect of the mandible.

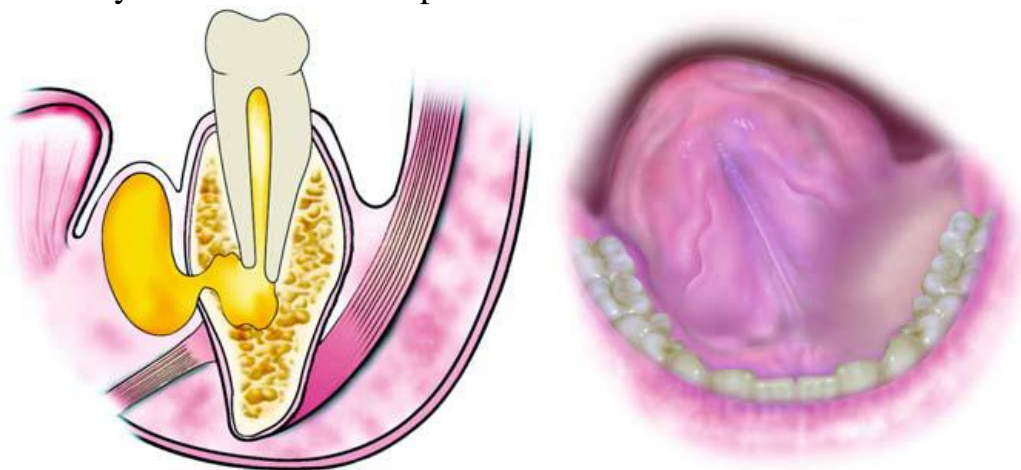
If the infection erodes through the medial aspect of the mandible above this line, the infection will be in the sublingual space. This is most commonly seen with premolars and the first molar.

If the infection erodes through the medial aspect of the mandible inferior to the mylohyoid line, the submandibular space will be involved. The mandibular third molar is the tooth that most commonly involves the submandibular space directly. The second molar may involve the sublingual or submandibular space, depending on the length of individual roots.

Connections: Submandibular and Lateral Pharyngeal spaces.

Signs and symptoms: Swelling of the mucosa of the floor of the mouth, resulting in elevation of the tongue towards the palate and laterally (little or no extraoral) swelling. The mandibular lingual sulcus is obliterated and the mucosa presents a bluish tinge. The patient speaks with difficulty, because of the edema, and movements of the tongue are painful.

Surgical approach: Intraoral approach (incision is lateral and along Wharton's duct and the lingual nerve) or extraoral approach (submandibular incision: approximately 1-2 cm below and parallel to the inferior border of the mandible).



(Sublingual space infection- above the attachment of mylohyoid muscle)

c) Submandibular space:

Location: Lies between the mylohyoid muscle and the overlying superficial layer of the deep cervical fascia. Bounded laterally by the inferior border of the body of the mandible, medially by the anterior belly of the digastric muscle, posteriorly by the stylohyoid ligament and the posterior belly of the digastric muscle. The posterior extent of the submandibular space communicates with the deep fascial spaces of the neck.

Content: Facial artery and vein, the submandibular salivary gland and the submandibular lymph nodes.

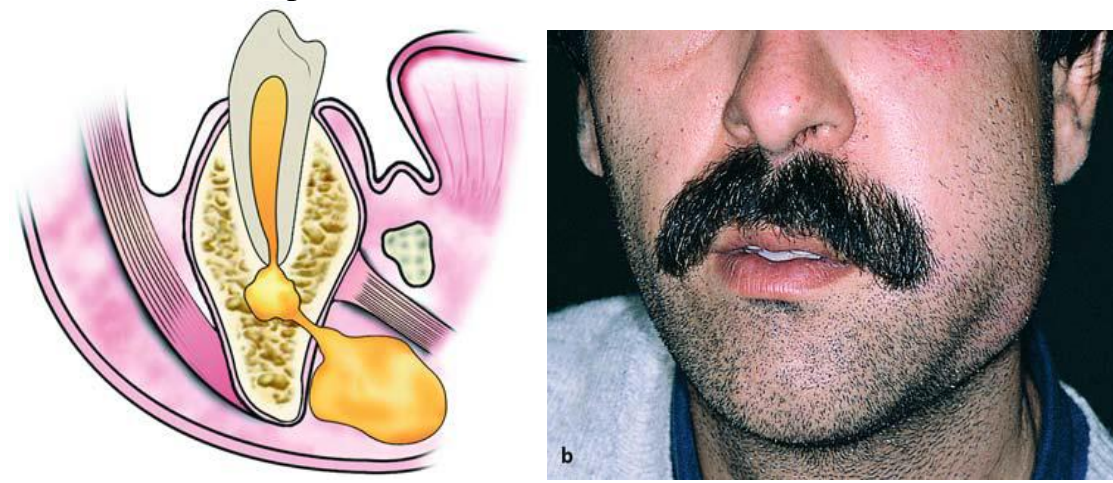
Etiology: Infection of this space may originate from the mandibular third molars (and second molar if their apices lies beneath the attachment of the mylohyoid

muscle). It may also be the result of spread of infection from the sublingual or submental spaces.

Connections: Submental, Sublingual, Lateral pharyngeal and Buccal spaces.

Signs and symptoms: Moderate swelling at the submandibular area, which spreads, creating greater edema that is indurated and redness of the overlying skin. In addition, the angle of the mandible is obliterated, while pain during palpation and moderate trismus due to involvement of the medial pterygoid muscle are observed as well.

Surgical approach: Extraoral approach (submandibular incision: approximately 1-2 cm below and parallel to the inferior border of the mandible).



(Submandibular space infection -below the attachment of mylohyoid muscle-)

- **Ludwig's angina:**

When the perimandibular spaces (submandibular, sublingual, and submental) are bilaterally involved in an infection, it is known as Ludwig's angina. The most common cause of Ludwig's angina is an odontogenic infection.

This infection is a rapidly spreading cellulitis that can obstruct the airway and commonly spreads posteriorly to the deep fascial spaces of the neck.

Severe swelling is almost always seen, with elevation and displacement of the tongue, and a tense, hard, bilateral induration of the submandibular region superior to the hyoid bone. The patient usually has trismus, drooling, and difficulty swallowing and sometimes breathing. The patient often experiences severe anxiety over the inability to swallow and maintain an airway.

This infection may progress with alarming speed and, thus, may produce upper airway obstruction that often leads to death. Management with a protocol of initially securing the airway and then performing early and aggressive I&D procedures. Antibiotic therapy plays only a supportive role in the management of severe odontogenic infections.



(Ludwig's angina)

Secondary mandibular spaces

1. *The masticator space:*

It is formed by the splitting the superficial layer of the deep cervical fascia to surround the muscles of mastication. Within this space, four compartments that exist. These four compartments clinically behave as separate spaces because, in most cases, only one compartment of the masticator space becomes infected. However, in severe or longstanding masticator space infections can involve all four compartments. These compartments referred to as separate spaces. They are:

a) **Submasseteric space:**

Location: Between the masseter muscle laterally and the lateral surface of the ascending ramus of the mandible medially. The zygomatic arch superiorly and the lower border of the mandible inferiorly.

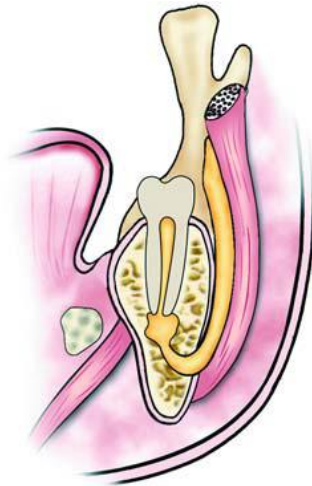
Content: Masseteric artery and vein.

Etiology: Infection most commonly as the result of spread from the buccal space or from soft tissue infection around the mandibular third molar (pericoronitis). Occasionally, an infected mandibular angle fracture causes a submasseteric space infection.

Connections: Buccal space, parotid space and the rest of the masticator space.

Signs and symptoms: The masseter muscle becomes inflamed and swollen. The patient also has moderate to severe trismus (due to the involvement of the masseter muscle).

Surgical approach: Intraoral approach (incision begins at the coronoid process and runs along the anterior border of the ramus towards the mucobuccal fold as far as the second molar).



Submasseteric space

b) Pterygomandibular space:

It is the space into which local anesthetic solution is injected during inferior alveolar nerve block.

Location: Between the medial pterygoid muscle medially and the medial surface of the ascending ramus laterally.

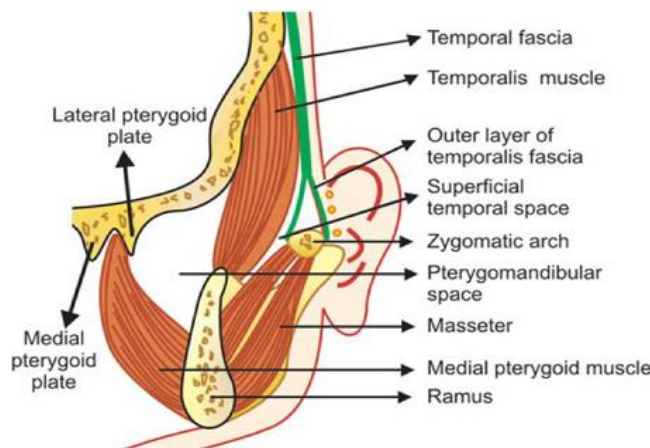
Content: Mandibular division of trigeminal nerve, Inferior alveolar artery and vein.

Etiology: The mandibular third molar is the most commonly associated tooth. Also may be caused by needle track infection from inferior alveolar nerve block.

Connections: Buccal, Lateral pharyngeal, Submasseteric, Deep temporal, Parotid, and Peritonsillar spaces.

Signs and symptoms: Little or no facial swelling is observed; however, the patient almost always has significant trismus. Therefore, trismus without swelling is a valuable diagnostic clue for pterygomandibular space infection.

Surgical approach: Intraoral approach (vertical incision, lateral and parallel to the pterygomandibular raphe) or extraoral submandibular approach.



(Pterygomandibular space infection)

c) **Superficial temporal space:**

Location: Bounded laterally by the temporal fascia and medially by the temporalis muscle.

Content: Temporal fat pad, Temporal branch of facial nerve.

Etiology: Rarely become infected and usually only in severe infections due to spread of infection from the infratemporal space, with which it communicates.

Connections: Buccal and Deep temporal spaces.

Signs and symptoms: Swelling over the temporal region, superior to the zygomatic arch and posterior to the lateral orbital rim.

Surgical approach: Extraoral approach (incision made horizontally, at the margin of the scalp hair and approximately 3 cm above the zygomatic arch).

d) **Deep temporal space:**

Location: Between the medial surface of the temporalis muscle and the temporal bone.

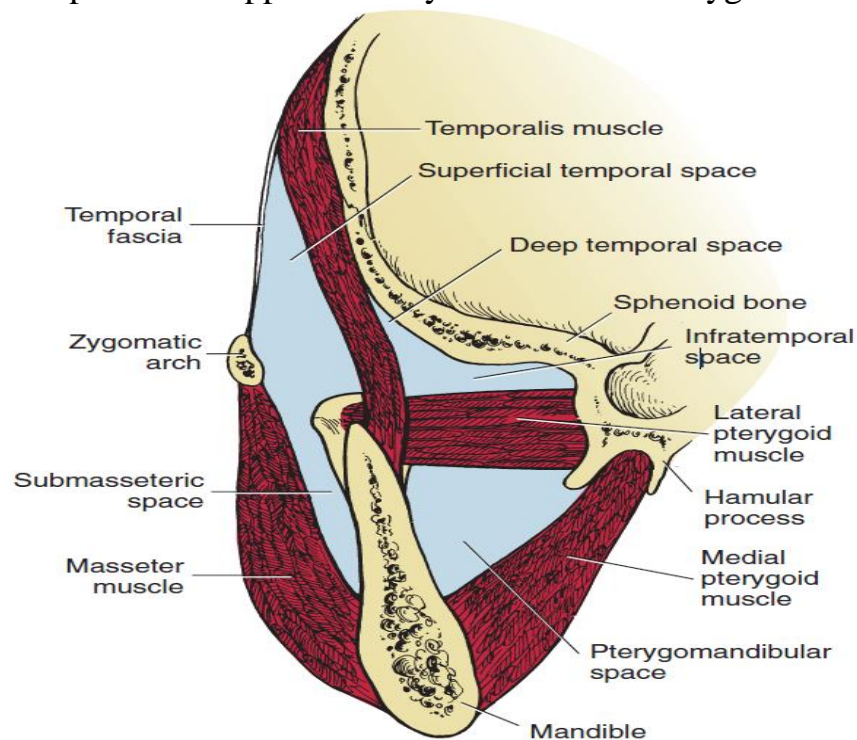
Content: Mandibular division of trigeminal nerve, Skull base foramina.

Etiology: Rarely become infected and usually only in severe infections due to spread of infection from the infratemporal space, with which it communicates.

Connections: Infratemporal space, Superficial temporal space, Inferior petrosal sinus.

Signs and symptoms: Swelling over the temporal region, superior to the zygomatic arch and posterior to the lateral orbital rim.

Surgical approach: Extraoral approach (incision made horizontally, at the margin of the scalp hair and approximately 3 cm above the zygomatic arch).



(Superficial and Deep Temporal spaces boundaries)

2. *Deep cervical fascial spaces:*

Extension of odontogenic infections beyond the spaces described above is an uncommon occurrence. However, when it does happen, involvement of the deep cervical spaces may have serious life threatening sequelae. Infection of the deep fascial spaces of the neck can compress, deviate, or completely obstruct the airway, invade vital structures such as the major vessels, and allow extension of the infection into the mediastinum and the vital structures it contains. These spaces are:

a) **Lateral pharyngeal space:**

Location: Extends from the base of the skull at the sphenoid bone superiorly to the hyoid bone inferiorly. The space is bounded laterally by the medial pterygoid muscle and the ramus of the mandible and medially by the superior pharyngeal constrictor muscle and bounded anteriorly by the pterygomandibular raphe and extends posteriorly to the prevertebral fascia.

Content: The styloid process and associated muscles and fascia divide the lateral pharyngeal space into an anterior compartment, which contains primarily loose connective tissue, and a posterior compartment, which contains the carotid sheath and cranial nerves IX (glossopharyngeal), X (vagus), and XII (hypoglossal).

Etiology: Lower third molars, Tonsils, Infection in neighboring spaces.

Connections: Pterygomandibular, Submandibular, Sublingual, Peritonsillar, and Retropharyngeal spaces.

Signs and symptoms: Trismus (as the result of inflammation of the medial pterygoid muscle), lateral swelling of the neck (especially between the angle of the mandible and the sternocleidomastoid muscle), swelling of the lateral pharyngeal wall causing it to bulge toward the midline, difficulty swallowing and fever.

Complications: When the lateral pharyngeal space is involved, the odontogenic infection is severe, may be progressing at a rapid rate, and has a direct effect on the contents of the space, especially those of the posterior compartment. These problems include thrombosis of the internal jugular vein, erosion of the carotid artery or its branches, and interference with cranial nerves IX, X, and XII. Other serious complication may arises if the infection progresses from the lateral pharyngeal space to the retropharyngeal space or beyond.

Surgical approach: Extraoral approach (submandibular incision), intraoral approach (incision in the lateral pharyngeal wall)

b) **Retropharyngeal space:**

Location: Lies behind the soft tissue of the posterior aspect of the pharynx. It is bounded anteriorly by the pharyngeal constrictor muscles and the retropharyngeal fascia, posteriorly by the alar fascia, superiorly by the base of the skull and ends inferiorly by the fusion of alar and prevertebral fascia (between the sixth cervical (C6) and fourth thoracic (T4) vertebrae).

Content: Loose connective tissue and lymph nodes.

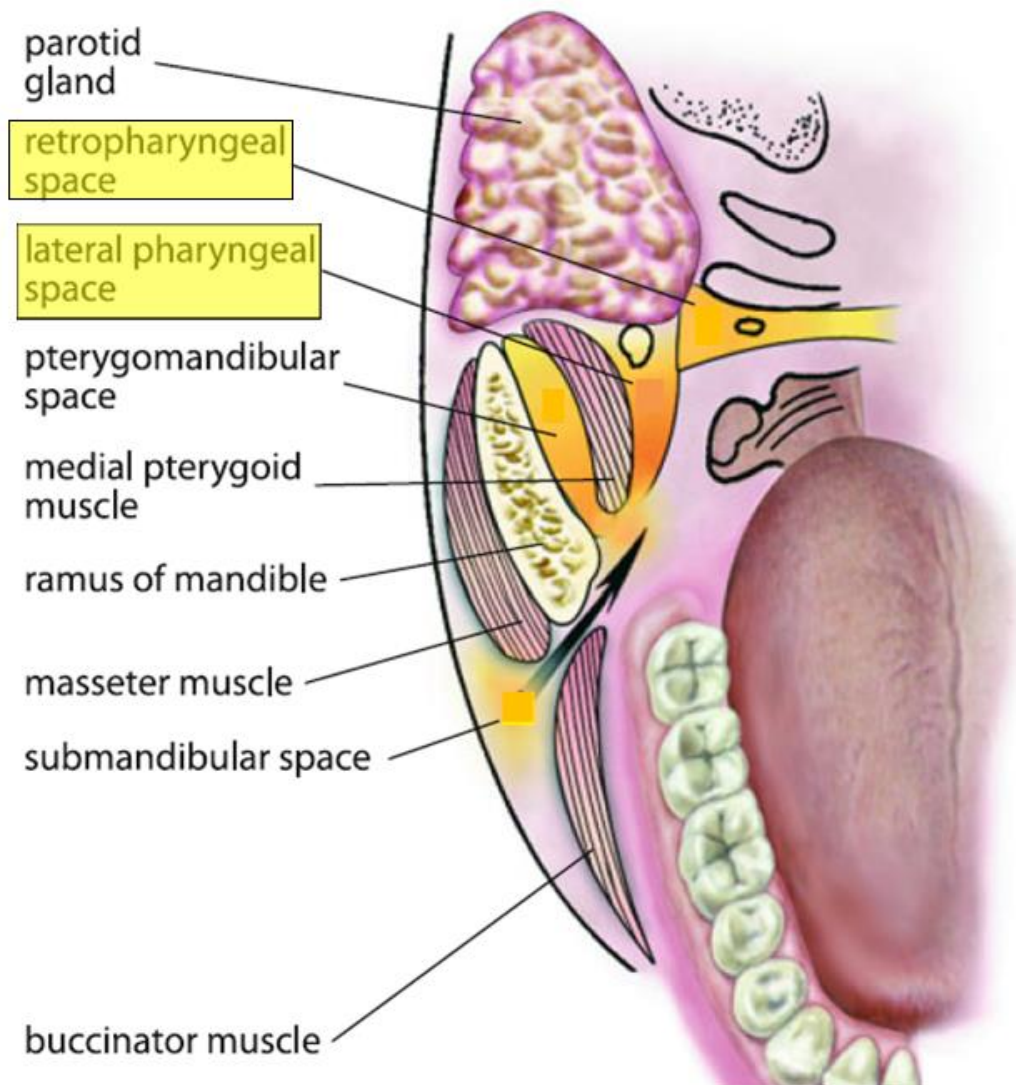
Etiology: Spread of infection from lateral pharyngeal space.

Connections: Lateral pharyngeal space, mediastinum.

Signs and symptoms: The same symptoms as those present in the lateral pharyngeal space appear clinically, with even greater difficulty in swallowing though, due to edema at the posterior wall of the pharynx.

Complication: Obstruction of the upper respiratory tract (due to displacement of the posterior wall of the pharynx anteriorly), rupture of the abscess and aspiration of pus into the lungs with asphyxiation and spread of infection into the mediastinum.

Surgical approach: Drainage through the lateral pharyngeal space.



(Lateral pharyngeal and Retropharyngeal spaces infection)

c) *Parotid Space:* للاطلاع

Location: Bound by the superficial layer of deep cervical fascia. The space extends from the external auditory canal to the angle of the mandible. It is located lateral to the carotid and parapharyngeal spaces and posterior to the masticator space.

Content: Parotid gland and its duct, the external carotid artery, the superficial temporal and facial artery, the retromandibular vein, the auriculotemporal nerve, and the facial nerve.

Etiology: spread of infection from lateral pharyngeal, parotitis, and sialadenitis.

Connections: Lateral pharyngeal, Pterygomandibular, Submasseteric space.

Signs and symptoms: Edema of the retromandibular and parotid region, trismus and difficulty in swallowing and pain mainly during chewing, which radiates to the ear and temporal region. In certain cases, there is redness of the skin and subcutaneous fluctuation. Also, a purulent exudate may be noted from the papilla of the parotid duct after pressure is applied.

Surgical approach: Extraoral approach (broad incision posterior to the angle of the mandible).



(Parotid Space infection)

d) *Prevertebral space:* للاطلاع

It is rarely involved in odontogenic infections because the prevertebral fascia fuses with the periosteum of the vertebral bodies

Location: This is a potential space and extends from the skull base to the coccyx. It is located anterior to the vertebral bodies, behind the prevertebral fascial layer of the deep layer of deep cervical fascia. Laterally it is limited by the fusion of the prevertebral fascia with the transverse processes of the vertebral bodies.

Etiology: Infection may be caused by osteomyelitis of the vertebrae, trauma, or may originate from the cervical or thoracic spine.

Signs and symptoms: The diagnosis is difficult to make. Patients may present with neck and/or back pain, just fever and/or neurologic dysfunction ranging from nerve root pain to paralysis. MRI is the imaging modality of choice to assess epidural or spinal cord involvement.