



## OROFACIAL INFECTIONS – ROUTE OF SPREAD – A COMPLETE REVIEW

<b>Hemalatha E</b>	UG, Karpaga Vinayaga Institute of Dental Sciences.
<b>Jothilakshmi D</b>	UG, Karpaga Vinayaga Institute of Dental Sciences.
<b>Sevvanthi S</b>	UG, Karpaga Vinayaga Institute of Dental Sciences.
<b>Dr. K. Balasankari</b>	PG, Department of Oral Pathology and Microbiology, Karpaga Vinayaga Institute of Dental Sciences.
<b>Dr. S. Pradeep Sankar</b>	Senior Lecturer, Department of Oral Pathology and Microbiology, Karpaga Vinayaga Institute of Dental Sciences.
<b>Dr. M. Sathish Kumar</b>	Professor and Head of the Department, Department of Oral Pathology and Microbiology, Karpaga Vinayaga Institute of Dental Sciences.

**ABSTRACT**

Odontogenic infections are constantly seen in the dental practice, being dental caries its main etiology; thus, dentists should be familiarized with its donation and operation as it can spread fleetly and have serious consequences. The purpose of this article is to give essential knowledge on the pathogenesis – spread, diagnosis, possible complications and treatment of odontogenic infections.

**KEYWORDS :** Odontogenic infections, spread through spaces, foci of infection.

**INTRODUCTION**

The oral cavity comprises several microbial flora that helps in homeostasis in normal conditions. The imbalance in the relationship of microbial flora with host and environmental factors lead to an infection [1]. In oral cavity, the infections which arise from odontogenic origin are unique in nature [2]. Odontogenic infections may present within or surrounding dentition, initiating from dental caries, periodontal diseases, pulpitis and may spread far away from their origin, invading deeper structures of face, oral cavity, head, neck and even mediastinum or vertebral column [1].

**ORIGIN**

Odontogenic infections have two major origins.

- **Periodontal Origin** – Through the deep periodontal pockets, the bacterial inoculations reach the underlying tissues.
- **Periapical Origin** – Occur later to pulpal necrosis and get to pulpal structures [1].

**ROUTE OF SPREAD**

The infection spreads to apex of the tooth as soon as the pathogen get access to the pulp chamber [2]. When the periodontal or periapical tissues of oral cavity get inoculated with pathogen that results in the spread of infection. Odontogenic infection always follows the route wherever is the least resistance. The infection spreads through the cancellous bone and reaches cortical plate. It may perforate easily when the cortical plate is thin and reaches the surrounding soft tissues. Collagenase, hyaluronidase, streptokinase are the periapical enzymes which help pathogenic microbes, dissolve through the organic matrix of bone and the pathogenic microbes ( bacteria) produce acids that eliminates mineral content of tooth [1].

The route of spread of infections should be via

- Tissues
- Blood
- Lymphatics [3].

**PROGRESSION**

Odontogenic infections should progress in three phases

1. Inoculation
2. Cellulitis

3. Abscess formation [2].

**FACTORS INFLUENCING THE SPREAD OF INFECTION**

- Virulence of pathogens
- Nutritional imbalance
- Patient's immune status
- Bone thickness adjacent to affront tooth
- Muscle attachment position in relation to root tip [3].

**CELLULITIS (PHLEGMON)****Definition:**

An acute, spreading pyogenic inflammation of the dermis and subcutaneous tissue is known as **cellulitis**, it usually complicates a wound, ulcer or dermatosis.

**Clinical Features:**

- Systemic features includes increased body temperature, fatigue, chills,
- Head ache, sweating, loss of appetite
- Inflammatory signs -rubor, tumor, calor, dolor, functio laesa

**Predisposing Factors:**

- Liposuction
- Injection (Subcutaneous) of illicit drugs [4,5]
- Recurrent cellulitis may occur after breast surgery for cancer
- After radical mastectomy [6]
- After breast conservation therapy, breast irradiation [7,8]
- Axillary lymph node dissection.

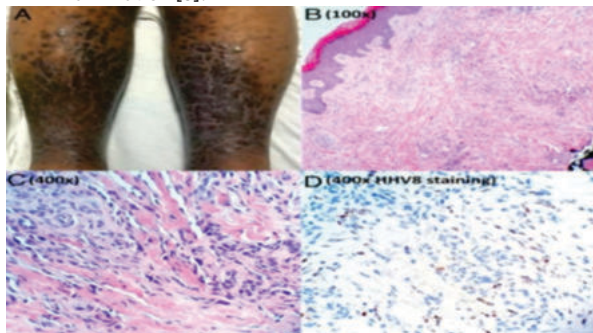
**Initiating Sources Of Infection:**

- Skin trauma or an underlying lesion are more common source.
- Animal or human bites
- When infection follows exposure to seawater (*Vibrio vulnificus*), fresh water (*Aeromonas hydrophila*), or aquacultured fish (*Streptococcus iniae*) suggests specific pathogens.

**Histologic Features:**

- Microscopy shows PMN leukocytes & occasional lymphocytes
- It contains serous fluid and fibrin causes separation of connective tissue or muscle fibres

- Cellulitis presents only a non specific picture of diffuse inflammation [9].



**Diagnosis :**

**History**

- Patient complaints of red ,hot ,swollen and tender area of skin
- Symptoms- fever, chills ,etc.
- Patient has recent history of trauma or bite on affected side.
- Patient complains of redness and swelling of eyelid may reports eye pain,impaired eye mobility and visual changes.

**Physical Exam**

- Appearance of red, swollen, tender skin that is warm to touch usually sufficient.
- Texture of skin resembles orange peel and be firm to touch
- Regional lymph nodes may be swollen and inflamed

**Tests**

- CBC to determine level of WBC ,a sensitive marker of infection
- Pus culture
- Antibiotic sensitivity tests
- X-rays ,CT or MRI is required to detect orbital cellulitis.

**Differential Diagnosis:**

- Cavernous sinus thrombosis
- Endocrine dysfunction
- Orbital myositis
- Orbital pseudotumor
- Wegener granulamatosis.

**Complications:**

- Sepsis
- Blindness
- Cavernous sinus thrombosis
- Meningitis
- Thrombophlebitis
- Necrotizing fascitis
- Alopecia [9].

**Treatment And Prognosis:**

- Administration of antibiotics including antianerobics along with removal of cause
- Patient are advised not to massage affected area with any medication to avoid further spread of infection [9].

**MAXILLARY SINUSITIS**

**Definition:**

An acute or chronic inflammation of maxillary sinus is often due to direct extension of dental infection ,but originates from infectious diseases and exanthematous diseases ; from local spread of infection in adjoining frontal or paranasal air sinus [9].

**Common Organisms :**

- *Streptococcus pneumoniae*, *H.influenzae* and *Moraxella catarrhalis*

- Gram negative bacilli
- Rhinovirus ,parainfluenza virus [9].

**Classification Of Rhinosinusitis :**

**Acute Maxillary Sinusitis**

- It results from acute periapical abscess or chronic inflammatory periapical lesion which involves sinus through direct extensio.
- Organisms- *S.pneumoniae*, *H.influenzae*

**Clinical Features:**

- Patients experience moderate to severe pain with swelling ,head ache
- Pain may referred to cheek, posterior teeth and ear
- Fever and malaise usually present
- Pain increases in supine position [9].

**Diagnosis:**

- Clinical signs and symptoms
- Transillumination
- Radiograph
- Nasal and sinus endoscopy
- CT scan [9].

**Histologic Features:**

- Lining shows typical acute inflammatory infiltrate with oedema of connective tissue
- Squamous metaplasia occurs sometimes [9].

**Treatment And Prognosis:**

- Prime objective is removal of infecting locus
- Antibiotic also administered because of infection [9].

**Chronic Maxillary Sinusitis**

- It continues for more than 3 months
- It may develop as an acute lesion subsides or may represent chronic lesion from onset
- Organisms- *Streptococcus*, *Bacteroides* or *Veilonella*

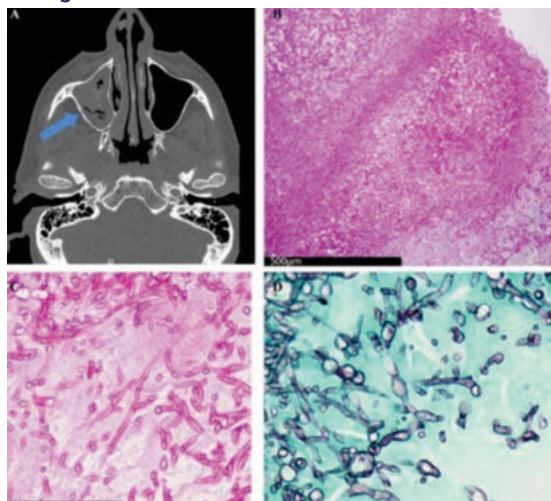
**Clinical Features:**

- Sometimes headache, fever , vague facial pain or upper tooth ache is present
- Patients may experience stuffy sensation on face
- There is mild discharge of pus into nose
- Rarely ,there will be dystropic calcification termed *antrolith* , which is detected through radiographs [9].

**Radiographic Features:**

- Clouding of the sinus due to hyperplastic tissue or fluid present
- CT scan shows mucosal thickening.

**Histologic Features:**



- Thickening of mucosal lining and development of numerous sinus *polyps*
- *Polyps*-hyperplastic granulation tissue with lymphocytes
- It is usually covered by ciliated columnar epithelium [9].

#### Treatment And Prognosis:

- It is usually treated by removing causative factors of disease.
- If the disease is because of dental infection then the prognosis is good.
- Infection from other sites may be difficult to eradicate [9].

### LUDWIG'S ANGINA

#### Definition:

Ludwig's angina is a complaint which is characterized by a serious, potentially life- hanging cellulitis, or connective tissue infection of the bottom of the mouth, generally being in adults with attendant dental infections and if left crude, may obstruct the airways, challenging tracheotomy [10].

#### Other Names:

Maligna angina, angina ludovici and morbus Strangularis [10].

#### Causes:

- It's caused by both **aerobes** and **anaerobes**, are of the cellulitis associated with Ludwig's angina.
- Generally, these include alpha – hemolytic streptococci, staphylococci and bacteroides groups [10,11].
- The route of infection is from lower molars or from pericoronitis, which is an infection of the epoxies circling the incompletely erupted lower (generally third) molars.
- It's most generally caused by lingo piercing, Immunocompromised patient, systemic illness such as diabetes mellitus, bilateral lobar pneumonia, severe anemia in gestation and internal deceleration [10,12,13,14].

#### Etiologic Factors:

- Odontogenic infection
- Trauma of odontogenic origin
- dental post sepsis

#### Symptoms And Signs:

- Rapidly developing board-like swelling of the floor of the mouth
- Consequent elevation of the tongue
- Swelling is firm, painful, diffuse and paucity of pus
- Difficulty in breathing as well as swallowing
- High fever, rapid pulse, fast respiration
- Serious risk of death by suffocation [9,10].

#### Other Symptoms:

- Moderate leukocytosis
- Swelling involves the neck and edematous of the glottis
- Its spread to the parapharyngeal spaces, carotid sheath and pterygopalatine fossa [10].

#### Treatment And Prognosis:

- Early recognition of incipient cases
- Maintenance of airway
- Intense and prolonged antibiotic therapy
- Extraction of affected tooth
- Surgical drainage
- Tracheotomy to prevent suffocation [9,10].

### CAVERNOUS SINUS THROMBOSIS

Cavernous sinus is one of the dural venous sinuses which present each sides of sella tursica. Cavernous sinus thrombosis is a infrequent and lethal condition of blood clot in cavernous sinus [15].

#### Etiology :

Cavernous venous thrombosis ( CST ) results from both contagious and non contagious causes.

#### Septic Causes

- Central fascial infections substantially within danger triangle of face, sinusitis, ethmoiditis, sphenoiditis, otitis media and mastoiditis

#### Aseptic Causes

- Trauma, surgery and pregnancy [15,16].

#### Bacterial Causes

- *Staphylococcus aureus*, *Streptococcus species*, *Pneumococcus*, gram positive species – *Corynebacterium*, *Actinomyces* and gram negative species – *Proteus*, *Hemophilus*, *Pseudomonas*, *Fusobacterium*, *Bacteroides*.

#### Fungal Infections

- Zygomycosis, Coccidiomycosis and Aspergillosis.

#### Parasitic Infections

- Toxoplasmosis, Malaria and Trichinosis.

#### Viral Causes

- Herpes simplex virus, Cytomegalovirus, Measles, Hepatitis, Human immunodeficiency virus.

#### Immunosuppression Conditions

- Uncontrolled diabetes mellitus, steroid usage, cancer, chemotherapy.

#### Risk Factors Of CST :

- Acute sinusitis, fascial infections, periorbital infections, thrombophilia, pregnant and postpartum women, women undergoes hormone replacement therapy / receiving oral contraceptives, antiphospholipid antibody syndrome, hyperhomocysteinemia, heparin induced thrombocytopenia, obesity, severe dehydration [15,17,18,19,20].

#### Clinical Presentation Of CST :

- Fever ( picket fence pattern characteristic for septic thrombophlebitis ), tachycardia, hypotension
- Altered mentation, lethargy and seizures are rare
- Periorbital edema, lid erythema, chemosis, ptosis, proptosis, painful eye movement, papilledema, retinal hemorrhage, decreased visual acuity, photophobia, diminished pupillary reflex, pulsating conjunctiva, blindness
- Sixth cranial neuropathy
- Ophthalmoplegia

**Internal Ophthalmoplegia** - non reactive pupil from paralysis of iris

**External Ophthalmoplegia**- from 3<sup>rd</sup>, 4<sup>th</sup> and 6<sup>th</sup> cranial neuropathy

- Horner syndrome, diminished sensation of face and impaired corneal reflex.

#### Investigations :

Neuroimaging is the optimal diagnostic test for cavernous sinus thrombosis, this can done with **contrast enhanced computer tomography (CT)** or **magnetic resonance imaging (MRI)**.

**CT venogram (CTV)** and **contrast enhanced MR venogram (MRV)** – highly sensitive

**Non contrast CT of head** – may divulge

- Various precise abnormalities like engorgement or dilation of superior and/or inferior ophthalmic veins

- Bulging of cavernous sinus ( lateral margins )
- Exophthalmous
- Presence of sphenoid or ethmoid sinusitis
- Mass lesions near sphenoid or pituitary gland.

#### Contrast Enhanced MRI Brain – To show

- Bulging of cavernous sinus
- Increased dural enhancement
- Absent flow void is seen [15,21]

#### CTV and enhanced MRV – To detect

- Dilation of cavernous sinus, enhancement, convexity of lateral wall ( usually concave ) on coronal views
- Heterogeneous and asymmetric filling defects after contrast, density of orbital fat increases, thrombosis in superior ophthalmic veins and branches leading to cavernous sinus
- Carotid artery narrowing, carotid arterial wall enhancement, cerebral infarcts, intraparenchymal hemorrhages, empyema, meningitis, cerebritis or abscess [15,22,23,24,25]
- Dural venous sinuses and cerebral veins are evaluated due to presence of multiple thromboses.

#### Blood Studies

- Increase in white blood cell ( WBC) count, C – reactive protein (CRP), erythrocyte sedimentation rate (ESR), D – dimer .

**Blood culture** – frequently positive.

#### Lumbar Puncture

- To exclude meningitis
- Increases in opening pressure and pleocytosis even in culture samples are negative

#### Thrombophilia Screening

- During anticoagulation therapy, it shows false results so it is delayed until treatment completion [15].

#### Differential Diagnosis :

- Cavernous sinus syndrome
- Painful Ophthalmoplegia [15].

#### Management Of CST :

- Broad spectrum antibiotics should be given intravenously that crosses blood brain barrier.
- High therapeutic doses of Aminoglycosides, Clindamycin are given.
- Mannitol is given intravenously in order to decrease the level of intracranial pressure.
- To reduce thrombosis, anticoagulant Heparin 20,000 units in 1500 ml of 5% dextrose is given [3].

### FOCAL INFECTION

#### Definition:

Focal infection is the metastasis from the focus of infection from organisms or their poisons affecting systemic health. It refers to a circumscribed area of tissue which is infected with exogenous pathogenic microorganisms and which is generally located near mucous on a cutaneous face [26].

#### Mechanism Of Focal Infection:

- There may be metastasis of microorganisms from an infected focus by either hematogenous or lymphogenous spread.
- poisons or poisonous products may be carried through the blood stream or lymphatic channels from a foci of infection to a distant point where they may incite a hypersensitive response in the apkins.

The microorganisms spread through vascular or lymphatic channels is a honored miracle, as is their localization on

apkins [26].

#### Significance Of Oral Foci Of Infection:

- Arthritis- Rheumatoid and Rheumatic fever types
- Valvular heart complaint – particularly Sub Acute Endocarditis
- Gastrointestinal conditions
- optical conditions
- Skin conditions
- Ocular disease
- Renal conditions [26].

#### Oral Foci Of Infection:

The sources of focal infection in the oral depression which may set up distant metastasis.

- Infected periapical lesion similar as the periapical granuloma, tubercle and abscess
- Teeth with infected root conduits
- Periodontal complaint
- Driving factors in Odontogenic Bacteremia

#### Triggering Factors:

- Chewing
- Personal oral aseptic measures
- Periodontal procedures
- Tooth birth
- Orthodontic procedures
- Endodontic procedures [27].

### FASCIAL SPACE INFECTIONS

In the head and neck region, the fascial spaces are the potential areas that present between the fascial layers. In a healthy person, there is no existence of fascial spaces. Infections occur in these spaces which is usually filled with loose connective tissue [3,28].

#### Classification :

Depending on mode of involvement, classified as:

#### Primary Spaces (Direct)

- Maxillary spaces
  - Canine space
  - Buccal space
  - Infratemporal space
- Mandibular spaces
  - Buccal space
  - Sub mental space
  - Submandibular space
  - Sub lingual space

#### Secondary Spaces (Indirect)

- Masseteric space
- Pterygomandibular space
- Temporal space (superficial and deep)
- Para pharyngeal space ( lateral and retropharyngeal )
- Pre vertebral space [3].

#### Spaces And Their Severity Scores :

Score 1 - Subperiosteal space, vestibular space, buccal space, infra orbital space.

Score 2 – Submandibular space, submental space, sublingual space, pterygomandibular space, sub masseteric space, temporal spaces.

Score 3 – Lateral pharyngeal, retropharyngeal pretracheal spaces.

Score 4 – Danger space, mediastinum, intracranial infections [3, 29]

#### Clinical Presentation Of Space Infections :

- Dyspnea
- Dysphagia
- Severe trismus
- Progressive swelling
- Edema of eyelids
- Abnormal eye signs
- Impaired vision / eye movement / both

- Change in quality of voice
- Lethargy
- Agitation, restlessness due to hypoxia
- Evidence of meningeal irritation such as severe headache, stiffness of neck, vomiting
- Level of consciousness is decreased [3].

Space infections	Source of infections	Contents (to be preserved)	Clinical features	Management
Canine space (or) Infraorbital space	Maxillary canines and premolars Skin infections of upper lip	Angular artery Angular vein Infraorbital nerve	Pain, tenderness, swelling of anterior cheek region, Obliteration – nasolabial folds and labial vestibule, Edema- lower eyelid and upper lip	Intraoral incision Drainage-intraorally/ percutaneously Aggressive antibiotic therapy Good hydration
Buccal space	Maxillary and mandibular premolars and molar teeth root apices above and below the buccinator attachment respectively	Buccal pad of fat Stenson's duct Facial artery Marginal mandibular nerve	Pain, tenderness, swelling of upper and lower lip, obliteration – buccal vestibule	Intraoral incision Drainage-intraorally/ percutaneously For mandibular buccal space infection – extraoral drainage Antibiotic therapy.
Superficial temporal space	Maxillary third molars Other space infections	Temporal fat pad Temporal branch of facial nerve	Pain, tenderness at temporal region Swelling – above and below the zygomatic arch and 'Dumb bell' shaped appearance Trismus	Incision and drainage Antibiotic therapy
Deep temporal space	Maxillary third molars Other space infections	Branches of internal maxillary artery Mandibular division of trigeminal nerve	Pain, swelling – infratemporal region and lateral aspect of eye Trismus Obliteration – buccal sulcus	If trismus is severe – extraoral incision If trismus is less severe – intraoral incision Drainage Antibiotic therapy
Submental space	Mandibular anteriors Infected symphyseal / parasymphyseal fractures Suppurations of submental lymphnodes	Submental nodes Anterior jugular vein	Pain and swelling in chin region Tenderness in lower anterior and chin region	Incision Drainage – transcutaneous approach Antibiotic therapy
Submandibular space	Infection from periapical region of molars Septic fractures of body of mandible Submandibular gland infections	Submandibular gland and nodes Facial artery Facial vein	Pain, tenderness Mild trismus Swelling – firm to soft in consistency Submandibular nodes – palpable and tender Intraorally, teeth involved is sensitive	Extraoral incision Drainage Facial artery and marginal mandibular nerve to be preserved Antibiotic therapy
Sublingual space	Periapical infection from mandibular teeth Sublingual gland infections	Lingual nerve Hypoglossal nerve Deep part of submandibular gland and duct	Pain, discomfort during deglutition Submandibular nodes – enlarged and tender Edema -elevation and protrusion of tongue Laryngeal edema – breathlessness	Intraoral incision – lingual nerve and Wharton's duct to be preserved Extraoral incision- facial artery, marginal mandibular nerve to be preserved Drainage Antibiotic therapy
Sub masseteric space	Infection from buccally placed mandibular third molar Septic foci from infected angle fracture Other space infections	Masseter muscle Ma	Pain, tenderness Swelling – firm and moderate size Severe trismus	Intraoral approach and extraoral approach

Pterygomandibular space	Mandibular third molars Usage of contaminated needle during inferior alveolar nerve block Septic fractures of mandible angle Other space infections	Inferior alveolar nerve Lingual nerve Long buccal nerve Nerve to mylohyoid	Pain at retromolar region Trismus Dysphagia Swelling near tonsillar pillar Deviation of uvula	Incision and drainage – intraoral approach If severe trismus – extraoral approach Drainage -by general anesthesia / mandibular nerve block Antibiotic therapy
Lateral pharyngeal space	Submandibular space, pterygomandibular space, tonsils and from region of lower third molar	Lymph nodes Carotid sheath Ascending pharyngeal artery Facial artery Glossopharyngeal nerve Hypoglossal nerve Spinal accessory nerve	External swelling – minimal Mouth opening – moderate limit Dysphagia Uvula – pushed to opposite side Rotation of neck to contralateral side Pharyngeal bulging	Intraoral approach – 1.5 cm incision Extraoral approach – 2.5cm incision Combined approach is preferred for treating lateral pharyngeal space infections Drainage
Retropharyngeal space	Lateral pharyngeal space, lymph nodes which drain into Waldeyer's ring Upper respiratory infections (rare)	Lymph nodes	Stiff neck Sore throat Dysphagia Swelling at lateral neck Fever Dyspnea Mediastinitis	Airway maintenance – by elective tracheostomy / fiber optic intubation Intra oral approach Extra oral approach [3].

**CONCLUSION**

Odontogenic infection is polymicrobial, being gram-negative bacilli and gram-positive cocci the most constantly set up; complications deduced from odontogenic infections can be murderous if not well controlled and the most important factor in the resolution of the infection is the elimination of the primary source along with antibiotic remedy. Is a constantly consulted pathology; thus, the clinician should know the basics on the operation in order to help it from progressing and putting the case's life at threat. This work provides information about odontogenic infection that allows to access its presentation and possible complications; as well as, guidelines for determination and management [30].

**REFERENCES**

- Shukla, Anand & Mehrotra, Divya. (2021). Odontogenic Infections: General Principles.
- Neal TW, Schlieve T. Complications of Severe Odontogenic Infections: A Review. *Biology* (Basel). 2022 Dec 8;
- Gaddipati, Rajasekhar. (2021). Fascial Space Infections.
- Binswanger IA, Kral AH, Blumenthal RN, Rybold DJ, Edlin BR. High prevalence of abscesses and cellulitis among community-recruited injection drug users in San Francisco. *Clin Infect Dis* 2000;
- Dancer SJ, McNair D, Finn P, Kolsto AB. Bacillus cereus cellulitis from contaminated heroin. *J Med Microbiol* 2002;
- Simon MS, Cody RL. Cellulitis after axillary lymph node dissection for carcinoma of the breast. *Am J Med* 1992;
- Mertz KR, Baddour LM, Bell JL, Gwin JL. Breast cellulitis following breast conservation therapy: a novel complication of medical progress. *Clin Infect Dis* 1998;
- Miller SR, Mondry T, Reed JS, Findley A, Johnstone PA. Delayed cellulitis associated with conservative therapy for breast cancer. *J Surg Oncol* 1998;
- Sundharam, Sivapatha & Prabhakar, Manoj & Kavitha, B.. (2020). Introduction. *Shafer's Textbook of Oral Pathology*, 9th edition.
- Quinn FB Jr. Ludwig angina. *Arch Otolaryngol Head Neck Surg*. 1999,
- Body piercing: To What Depths? An Unusual Case and Review of Associated Problems. *Plastic & Reconstructive Surgery*. 115(3):50E-54E, March 2005.
- Williams, Andrew M. M.A., M.R.C.S.(Ed); Southern, Stephen J. F.R.C.S.(Plast.). Koenig, Laura M.; Carnes, Molly (1999). "Body Piercing: Medical Concerns with Cutting Edge-Fashion". *Journal of General Internal Medicine* 14 (6): 379-385.
- Zadik Yehuda, Becker Tal, Levin Liran (January 2007). "Intra oral and perioral piercing". *J Isr Dent Assoc* 24 (1):
- Newlands C, Kerawala C (2010). *Oral and maxillofacial surgery*. Oxford: Oxford University Press. Pp. 374-375.
- Plewa MC, Tadi P, Gupta M. Cavernous Sinus Thrombosis. 2023 Jul 3. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. DiNubile MJ. Septic thrombosis of the cavernous sinuses. *Arch Neurol*. 1988 May;
- Dinkin M, Patsalides A, Ertel M. Diagnosis and Management of Cerebral Venous Diseases in Neuro-Ophthalmology: Ongoing Controversies. *Asia Pac J Ophthalmol* (Phila). 2019 Jan-Feb;
- Torretta S, Guastella C, Marchisio P, Marom T, Bosis S, Ibba T, Drago L, Pignataro L. Sinonasal-Related Orbital Infections in Children: A Clinical and Therapeutic Overview. *J Clin Med*. 2019 Jan 16

- Darmawan G, Hamijoyo L, Oehadian A, Bandiara R, Amalia L. Cerebral Venous Sinus Thrombosis in Systemic Lupus Erythematosus. *Acta Med Indones*. 2018 Oct;
- Mulvey CL, Kiell EP, Rizzi MD, Buzi A. The Microbiology of Complicated Acute Sinusitis among Pediatric Patients: A Case Series. *Otolaryngol Head Neck Surg*. 2019 Apr;
- Berge J, Louail C, Caillé JM. Cavernous sinus thrombosis diagnostic approach. *J Neuroradiol*. 1994 Apr;
- Branson SV, McClintic E, Yeatts RP. Septic Cavernous Sinus Thrombosis Associated With Orbital Cellulitis: A Report of 6 Cases and Review of Literature. *Ophthalmic Plast Reconstr Surg*. 2019 May/June
- Deliran SS, Sondag L, Leijten QH, Tuladhar AM, Meijer FJA. [Headache: consider cavernous sinus thrombophlebitis]. *Ned Tijdschr Geneeskd*. 2018 Aug 16;
- Fujikawa T, Sogabe Y. Septic cavernous sinus thrombosis: potentially fatal conjunctival hyperemia. *Intensive Care Med*. 2019 May;
- van der Poel NA, de Witt KD, van den Berg R, de Win MM, Mourits MP. Impact of superior orbital vein thrombosis: a case series and literature review. *Orbit*. 2019 Jun;
- K. Malathi\*, Hima Bindu Reddy C., Varshini S., N. Srividya and K. Vijaykumar, Focal Infection, 3-2022
- Ranjitkumar Patil, Shailesh M. Gondivkar, Amol R. Gadgil, Manoj Yuvanati, Mugdha Mankar (Gadgil), Manoj Likhitar, Sachin Sarode, Shankargouda Patil, "Role of oral foci in systemic diseases: An update," *Int J Contemp Dent Med Rev*, vol. 2017, Article ID: 040117, 2017.
- Shapiro DS, Schwartz DR. Exposure of laboratory workers to Francisella tularensis despite a bioterrorism procedure. *J Clin Microbiol*. 2002;
- Mirochnik R, Araidy S, Yaffe V, Imad Abu El-Naaj severity score As a prognostic factor for Management of Infections of odontogenic Origin, a study of 100 cases. *Open J Stomatol*. 2017;
- Ortiz R, Espinoza V (2021) Odontogenic Infection. Review of the Pathogenesis, Diagnosis, Complications and Treatment. *Res Rep Oral Maxillofac Surg* 5:055.