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'MAXILLARY AIR SINUS' -ITS IMPORTANCE IN DENTISTRY- A NARRATIVE REVIEW

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INTRODUCTION:

Structures Anatomical of the Maxillary Sinus

The largest paranasal sinus, the pyramid-shaped maxillary sinus (also known as the antrum of Highmore), is situated in the maxilla. Through the semilunar hiatus, it empties into the middle meatus of the nose [1]. It is situated inside the maxilla's body, but when it gets big, it may extend into the zygomatic and alveolar processes. It is situated to the side of the nasal cavity and below the orbit. It has a pyramidal form, with the lateral nasal wall serving as the base and the maxillary zygomatic process as the apex. [3]

It has three recesses: an inferiorly orientated alveolar recess bounded by the maxilla's alveolar process; a laterally orientated zygomatic recess bounded by the zygomatic bone; and an inferiorly orientated infraorbital recess bounded by the maxilla's inferior orbital surface. Cartilage makes up the majority of the medial wall.[2] [Fig:1]

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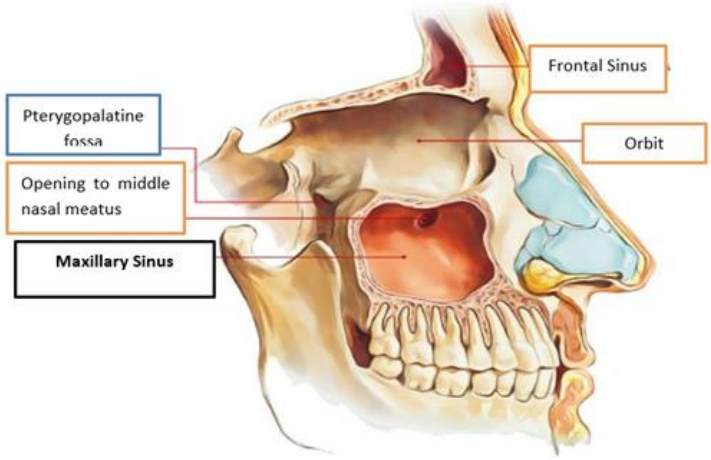

FIG-1: MAXILLARY SINUS

[Source: Drake RL, Vogl A W, Mitchell AWM. Gray's Anatomy for Students.4th Edi, Susan Standring, Elsevier, 2020, Philadelphia, USA.]

A sizable, uneven opening that connects to the nasal cavity is seen in the disarticulated bone on the nasal wall of the maxillary sinus, also known as the base. The following bones in the articulated cranium significantly reduce the size of this aperture:

The vertical portion of the palatine behind, the ethmoidal process of the inferior nasal concha below, the uncinate process of the ethmoid above, and below are the locations of these structures, a tiny portion of the anterior and superior lacrimal.

On the lateral nasal wall, there is an aperture into the semilunar hiatus via which the sinus connects. Cartilage makes up the majority of the medial wall. [2,4] The alveolar canals, which run along the posterior wall, carry the posterior superior alveolar veins and nerves to the molar teeth. The alveolar process forms the floor, which, if the sinus is ordinary in size, is level with the nose's floor; if the sinus is large, it extends below this level. The roots of the first and second maxillary molar teeth protrude into the antrum's floor in a number of conical processes; in certain instances, the teeth's apices may even puncture the surface. The floor of the orbit becomes the roof. Infraorbital nerves and vessels pass via it. The maxillary sinus may eventually grow to the point where it surrounds the roots of the maxillary posterior teeth and extends the boundaries into the zygomatic bone body as people mature.[5]

One of the four paranasal sinuses, the maxillary sinus is also called the antrum of Highmore. If the maxillary posterior teeth are lost, the sinus may enlarge even more, reducing the bony floor of the alveolar process until only a thin shell of bone is visible. It is a pyramid-shaped hollow situated above the upper jaw's teeth and beneath the eyes in the maxilla.

Development:

The third month of pregnancy is when the maxillary sinuses start to develop. They are tiny at birth, but as the maxilla grows, they progressively enlarge until they reach their maximum size when an adult.

Anatomy

1. Ostium: The nasal cavity's aperture through which mucus can drain.

2. Walls: The sinus is divided from the orbit above, the nasal cavity medially, and the oral cavity below by a thin bone wall.

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3. Lining: The Schneiderian membrane, a ciliated mucous membrane that helps transport mucus towards the ostium, lines the inner surface.

Nervous System Supply:

• The maxillary nerve (V2), a branch of the trigeminal nerve (cranial nerve V), innervates the maxillary sinus predominantly.

The **infraorbital nerve** supplies the anterior and middle regions' mucosa.

o **Anterior Superior Alveolar Nerve**: Provides blood to the upper incisors and the mucosa of the anterior sinus.

o **Middle Superior Alveolar Nerve**: Provides blood to the premolars and the mucosa of the middle sinus.

o **Posterior Superior Alveolar Nerve**: Provides blood to the molars and the mucosa of the posterior sinus.

Blood Suply:

Arterial Suply:

The maxillary artery's branches provide the arterial blood flow.

1. Infraorbital artery: Provides blood to the middle and anterior regions.

2. The posterior sections are supplied by the posterior superior alveolar artery.

3. The greater palatine artery has a role in blood circulation as well.

Venous Drainage:

The pterygoid plexus of veins facilitates venous drainage, which ultimately empties into the maxillary vein.

Lymph Drainage:

• The submandibular lymph nodes receive the lymph that drains from the maxillary sinus.

• The deep cervical lymph nodes and the retropharyngeal lymph nodes may also experience some lymphatic drainage.[3,6,7]

Uses and Functions of the Maxillary Sinus:

One of the four pairs of paranasal sinuses in the human body, the maxillary sinuses perform a number of vital activities. Their contributions to the respiratory system, nasal cavity function, and general craniofacial health go much beyond simple anatomical duties.

Functions:

1. Weight Loss of the Skull: The maxillary sinuses contribute to a reduction in the skull's total weight. The head becomes lighter as a result, making it simpler to balance on the cervical spine.[6]

2. **Heating and Humidifying Inhaled Air**: The air that enters the nasal passages through the sinuses is heated and humidified in part by the sinuses. By doing this, the air is helped to become more moist and closer to body temperature before it enters the lungs [7].

3. Improvement of Voice Resonance: The paranasal sinuses, including the maxillary sinuses, serve as the voice's resonating chambers. They affect the voice's timbre and tone, which adds to its resonance.[1]

4. Protection Against Trauma: The energy from facial trauma can be absorbed and dispersed by the cushioning effect of the air-filled sinuses. This aids in preventing damage to important structures including the brain and eyes.[8]

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5. Immune defence and mucus production: Dust, infections, and other particles are captured in mucus, which is secreted by the mucous membrane lining the maxillary sinus. Mucus is moved towards the nasal cavity by the cilia on the epithelial cells, where it can be ingested or ejected. The body produces mucus as part of the immunological defence system, which aids in the prevention of infections.[1]

6. Olfactory Function Enhancement: By increasing airflow and hence raising the effectiveness of the olfactory epithelium in the upper nasal cavity, the sinuses help to improve olfactory function.[9]

Uses:

The maxillary sinus has various practical uses and consequences in medicine and dentistry, while being most recognised for its anatomical and physiological functions.

1. Lightening the Skull: The maxillary sinuses contribute to the skull's lightness without sacrificing strength. This anatomical trait is essential for preserving the head's balance and structure.[10]

2. Warming and Humidifying Inhaled Air: Mucus is produced by the mucous membrane lining the sinuses, which warms and humidifies the air that enters the nasal passages. This aids in defending the respiratory system against infections and dryness.[11]

3. Voice Resonance: The sinus cavities aid in the voice's resonance, which improves the vocal quality and tone. Speech and communication are affected by this resonance, which is an important component of vocal sound creation.[12]

4. Protection Against Pathogens: Particulate matter and pathogens are captured and released by the cilia and mucus in the mucous membrane lining the sinuses. Infection prevention and respiratory health maintenance depend on this function.[13]

5. Support for Dental Procedures: Understanding the anatomy of the sinuses is crucial for implant implantation and the management of problems such as oroantral fistula. In dental surgery, careful preparation and execution can reduce risks and enhance results.[14]

6. *Medical Imaging and Diagnosis*: The maxillary sinus is a crucial region in medical imaging, especially for the diagnosis of tumours, sinusitis, and other diseases. Accurate diagnosis and treatment planning depend on imaging modalities like MRI, CT, and CBCT scans.[15]

Disorders of the Maxillary Sinus:

Common Disorders:

1.Sinusitis: Inflammation of the sinus lining, frequently brought on by allergies, other irritants, or infections (bacterial, fungal, or viral).

o Acute Sinusitis: Usually subsides in less than four weeks.

o Chronic Sinusitis: Remains untreated for longer than 12 weeks.

2. Sinus Cysts and Polyps: Benign growths called sinus polyps and cysts can obstruct sinus drainage, resulting in pain or infection.

3.Tumours of the maxillary sinus: uncommon but potentially benign or malignant.

4.Fungal infections of the sinuses: invasive fungal sinusitis, also known as fungal balls, are more common in immunocompromised people.

5.Dental-Related Problems: The maxillary sinus can get infected by dental treatments or infections that start with the upper teeth.

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Role of Maxillary Sinus in Dentistry :

Implications for Dentistry: [16,17]

1.In order to provide room for dental implants, a frequent implant dentistry treatment called sinus lift surgery involves adding bone to the upper jaw near the molars and premolars.

2.An irregular connection between the maxillary sinus and the oral cavity known as an oroantral fistula is frequently the outcome of tooth extraction or other dental procedures. needs to be managed carefully to avoid infection.

3.Dental infections: Odontogenic sinusitis, or sinusitis, can result from upper tooth infections that migrate to the maxillary sinus.

4.Implant placement: When considering dental implants in the posterior maxilla, the location and condition of the maxillary sinus are important factors to take into account.

5.Radiographic Examination: In dental practice, imaging investigations are crucial for evaluating the architecture and pathology of the maxillary sinus. These studies include panoramic radiography, cone beam computed tomography (CBCT), and other radiographic techniques.

Significance of the Maxillary Sinus with Dental Implants:

When it comes to implant dentistry, the maxillary sinus is quite important, especially for implants positioned in the posterior maxilla. These are the main points to remember:

1. Anatomical Points to Remember: [18–20]

Maximum Sinus Distance:

• Because of the close proximity of the maxillary sinus, the posterior maxilla frequently has restricted bone height, which might make implant placement more difficult.

Pneumatization of the Sinus:

• The maxillary sinus may enlarge (pneumatize) following tooth loss, significantly decreasing the height of accessible bone for implants.

2. Procedures for Sinus Lifts:

Lateral Sinus Elevation:

• A surgical technique in which bone graft material is used to raise the sinus membrane sufficiently to allow for the implantation of implants.

Transalveolar (Osteotome) Elevation:

• A less invasive procedure in which osteotomes and bone graft material are used to raise the sinus floor through the alveolar ridge.

Success Ratios:

• Research indicates that implants utilising sinus lift treatments have a high success rate, especially when superior bone graft materials and appropriate surgical methods are employed.

3. Implant Success and Stability: [21–23]

Primary Stability

Because the posterior maxilla has less bone density than other jaw locations, achieving primary stability in this area can be difficult. Implants might have a more stable base because to sinus enlargement.

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The process of osseointegration

Better osseointegration results from effective sinus lift and bone grafting procedures, which raises the long-term viability of implants in the posterior maxilla.

4. Risk Control:

Problems:

• Infection, migration of the graft material, and perforation of the sinus membrane are possible consequences. To reduce these risks, meticulous planning and appropriate surgical technique are crucial.

Following Surgery:

• Providing adequate postoperative care, such as nasal decongestants and antibiotics, can aid in the prevention of problems and encourage the healing process.

Diseases and Disorders Involving the Maxillary Sinus:

Many illnesses and conditions can affect the maxillary sinus; some of these conditions may need to be treated medically or surgically. An extensive summary of typical maxillary sinus conditions is provided below:

1. Maxillary Sinus Disease

a). Acute Sinusitis of the Maxilla:

• An upper respiratory viral infection that frequently manifests as a maxillary sinus infection, causing inflammation and sinus outflow obstruction.

• Fever, purulent nasal discharge, congestion in the nose, and facial pain are among the symptoms.

• Decongestants, nasal corticosteroids, and occasionally antibiotics are used in treatment.

b) Chronic Sinusitis of the Maxilla:

• A disorder where the maxillary sinus remains inflamed for longer than 12 weeks.

• Allergies, nasal polyps, recurrent infections, and anatomical anomalies are among the causes.

• Prolonged use of nasal corticosteroids, saline irrigation, antibiotics, and, in certain situations, surgery (functional endoscopic sinus surgery, or FESS) may be part of the treatment plans. [24,25]

2. Fistula Oroantral

an irregular exchange of information between the maxillary sinus and the oral cavity, frequently brought on by dental operations such as tooth extractions. Recurrent sinusitis, foul breath, and liquid regurgitation from the nose are among the symptoms.

Handling: While smaller fistulas may heal on their own or be treated with local flaps, larger ones may need to be surgically repaired using methods such as the palatal flap or buccal advancement flap. [14]

3. Sinus Polyps and Cysts

Sinus Cysts:

Often asymptomatic, mucoceles or retention cysts within the maxillary sinus can cause face pain or blockage if they get large.

Polyps in the nose:

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• Mild growths that originate from the sinus mucous membranes and are linked to aspirin sensitivity, asthma, and persistent inflammation.

• May result in diminished sense of smell, chronic sinusitis, and blockage.

Therapy:

• In cases that are refractory, management options include surgical removal, saline irrigation, and nasal corticosteroids.[26]

4. Maximum Sinus Growths

a) Innocent Tumours:

• Contains papillomas, fibromas, and osteomas. frequently asymptomatic but can result in blockage or a cosmetic abnormality.

b). Cancerous Tumours:

• Contains adenocarcinoma, squamous cell carcinoma, and other types. Constant blockage of the nasal passages, nosebleeds (epistaxis), and swelling or pain in the face are the symptoms.

• Needs extensive care, including as chemotherapy, radiation therapy, and surgery.[27]

5. fungus-related infections

a)The fungus ball, or mycetoma:

• A non-invasive fungal infection, frequently brought on by species of Aspergillus. Individuals may exhibit blockage and unilateral nasal discharge.

• The fungal mass is usually surgically removed as part of the treatment.

b) Fungal Sinusitis With Invasion:

• A severe variant that typically affects those with impaired immune systems, such as those receiving immunosuppressive medication, diabetic patients, or leukaemia patients.

• Spreads quickly to infiltrate adjacent tissues, requiring debridement surgery and strong antifungal therapy. [28, 29]

Maxillary Sinus Significance in Clinical Dental Practice:

In dentistry, the maxillary sinus is important for several reasons, especially when it comes to dental implants, sinus-related dental diseases, and some surgical techniques. The following are the main ideas:

1. **Dental Implants**

Surgery for a sinus lift:

• In order to install dental implants, sinus lift surgery is used to raise the posterior maxilla's vertical bone height.

• Techniques: There are primarily two methods.

o Lateral Window Technique: To insert the bone graft material, a window is made on the sinus's lateral wall, and the sinus membrane is raised.

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o Transalveolar (Crestal) Technique: This less invasive method uses osteotomes to elevate the sinus floor through the alveolar ridge[19,20].

2. **Fistula Oroantral**

Management and Aetiology:

• Cause: Frequently stems from dental extractions, especially those of the upper molars, whose roots may extend into or near the maxillary sinus.

• Symptoms: Recurrent sinus infections, foul breath, and nasal regurgitation of liquids.

• Treatment: Surgical closure with flaps like the palatal or buccal advancement flaps may be used.[14]

3. **Diseases of the teeth and sinuses**

Non-Orthodontic Sinusitis:

• Dental infections can travel to the maxillary sinus and result in sinusitis, especially if they originate from the upper molars and premolars. consist of nasal congestion, purulent nasal discharge, and face pain. requires treating the sinusitis with antibiotics and decongestants as well as the underlying tooth infection with procedures like extractions and root canal therapy.[30]

4. **Maxillary Sinus and Radiographic Evaluation**

Imaging Techniques: Cone beam computed tomography (CBCT), conventional CT scans, and panoramic radiography are among the imaging modalities that are used to evaluate anatomical variances, plan dental implants, and diagnose sinus disorders. [31]

5. **Dental Procedures and Sinus Pathologies**

a) Mucous Retention Cysts and Polyps: These are frequent observations in the maxillary sinus that can cause problems for dental operations. usually asymptomatic and don't need to be treated until they restrict the flow of fluid or cause other problems. [32]

CONCLUSION:

The maxillary sinuses provide a number of vital roles, including protecting against injuries, improving voice resonance, lowering skull weight, and supporting respiratory health. These functions highlight the maxillary sinuses' significance for normal function and the integrity of the craniofacial structure as a whole.

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