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COMPREHENSIVE MANAGEMENT OF INFRAORBITAL INFLAMMATORY CONDITIONS: FROM ANATOMY TO CLINICAL SOLUTION

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Abstract: Purulent-inflammatory processes in the infraorbital region represent one of the most complex and potentially life-threatening forms of maxillofacial pathology. This is due to the anatomical proximity of the region to the orbital and intracranial structures, as well as the rapid spread of infection through facial tissue spaces. A particularly serious clinical form is the so-called combined (associated) abscess and phlegmon, characterized by the coexistence of localized purulent foci and diffuse tissue inflammation. This article aims to systematize current knowledge regarding the anatomical and topographic features of the infraorbital area, pathogenetic mechanisms of purulent infection, diagnostic algorithms, and modern principles of comprehensive treatment. Particular attention is given to surgical strategies, antibiotic therapy, and interdisciplinary collaboration in the context of orbital and intracranial complication risk. The importance of early imaging, sanitation of odontogenic sources, and the standardization of treatment protocols is emphasized as a means of reducing the likelihood of severe consequences.

Keywords: infraorbital region; phlegmon; abscess; maxillofacial surgery; odontogenic infection; CT diagnostics; purulent-inflammatory complications; orbital complications; surgical treatment

Introduction

Purulent-inflammatory diseases of the maxillofacial region remain a significant part of emergency dental and surgical care despite the development of preventive medicine and the widespread use of antibiotics. Inflammatory processes localized in the infraorbital region are of particular clinical relevance due to the complex anatomical and topographical structure of this area and its functional significance. The infraorbital zone is characterized by its close relationship with the orbit, paranasal sinuses, the maxillary bone, and venous channels that anastomose with intracranial sinuses. These features create a high risk of developing severe complications such as orbital phlegmon, cavernous sinus thrombosis, meningitis, and sepsis.

Among the inflammatory conditions in this zone, the combined form of abscess and phlegmon is especially significant. It involves the presence of a localized purulent cavity along with the rapid spread of exudate through adjacent cellular spaces. This clinical course is aggressive and may initially present with nonspecific symptoms, complicating diagnosis and requiring a high degree of clinical vigilance.

Etiologically, such conditions are most commonly odontogenic in origin, often associated with complicated dental caries, acute periodontitis, abscesses, or chronic infections in the

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maxillary premolars and molars. However, rhinosinusogenic, traumatic, or hematogenous pathways of infection spread are also possible. A key diagnostic challenge is that these purulent conditions can mimic sinusitis, allergic edema, or facial trauma, resulting in delayed diagnosis and worsening prognosis.

Given the life-threatening potential and high clinical impact of these infections, a deeper understanding of their pathogenesis, diagnostic complexity, and multidisciplinary treatment strategies is essential. This article seeks to summarize current concepts of infraorbital infections from the perspective of maxillofacial surgery, with a focus on anatomical features, routes of infection spread, visualization techniques, and comprehensive therapeutic approaches.

Anatomical and Pathogenetic Aspects of the Infraorbital Region

From the perspective of maxillofacial surgery, the infraorbital region represents a complex anatomical zone with a high risk of rapid inflammatory spread. It lies within the boundaries of the **regio infraorbitalis**, bordered superiorly by the infraorbital rim, inferiorly by the alveolar process of the maxilla, medially by the nasolabial fold, and laterally by the buccal region. The key anatomical structure determining the clinical relevance of this area is the **infraorbital canal** (canalis infraorbitalis), which transmits the infraorbital nerve, artery, and vein. These structures are extensions of the **maxillary nerve (n. maxillaris)** and provide sensory innervation and vascular supply to the lower eyelid, cheek, nasal ala, and upper lip.

A critical pathogenetic factor underlying the aggressiveness of inflammation in this area is the presence of loose connective tissue with poorly defined fascial boundaries, which facilitates the rapid horizontal and vertical spread of purulent exudate. The infraorbital space communicates directly with the buccal, temporal, and pterygopalatine spaces, and through the inferior orbital fissure with the orbital contents. Additionally, venous anastomoses between the facial veins and cavernous sinus create a pathway for retrograde embolization and intracranial complications such as **cavernous sinus thrombosis** and **meningoencephalitis**.

The most frequent infectious source in the infraorbital area is odontogenic, typically arising from the roots of upper premolars and molars, which are anatomically close to both the anterior wall of the maxillary sinus and the infraorbital canal. Infection can spread hematogenously, via lymphatics, or along the paths of neurovascular bundles and bone marrow canals. Iatrogenic contamination following inadequate endodontic or surgical treatment must also be considered as a potential trigger.

Therefore, the behavior of purulent inflammation in this region is dictated by several factors: anatomical proximity to vital structures, tissue architecture conducive to rapid spread, the presence of multiple communications between facial spaces, and the high probability of odontogenic origin. These features demand not only clinical vigilance but also a clear understanding of spatial relationships within the region. Timely recognition of progression

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from localized abscess to diffuse phlegmon and the identification of mixed forms—which may initially present as simple edema—are crucial for effective intervention.

Etiology and Classification of Infraorbital Infections

From an etiological standpoint, the vast majority of infraorbital infections result from bacterial infiltration originating from odontogenic foci. The most common sources are complicated caries, acute and chronic apical periodontitis, destructive maxillary osteomyelitis, and untreated granulomas or cysts in the area of upper premolars and molars. Teeth #24–26 play a particularly important role, as their roots are situated in close proximity to the anterior wall of the maxillary sinus and the infraorbital canal. Iatrogenic factors such as sinus perforation during tooth extraction or endodontic treatment complications may also act as triggers.

In addition to odontogenic causes, **rhinosinusogenic forms** may occur due to the extension of infection from the maxillary, ethmoidal, or frontal sinuses in cases of acute or chronic sinusitis. **Traumatic injuries** to the facial soft tissues and fractures of the infraorbital rim with disruption of bony integrity create favorable conditions for secondary infection. Less frequently, **dermatogenic infection** may arise from infected skin lesions such as boils or carbuncles in the cheek and upper lip areas.

From a **pathomorphological and clinical** perspective, infraorbital infections are classified as follows:

1. **Abscess** – a localized purulent collection encapsulated within a single anatomical space. Clinically, it presents as localized swelling, fluctuation, clearly defined margins, and marked tenderness on palpation.
2. **Phlegmon** – a diffuse, non-encapsulated purulent inflammation spreading through soft tissue planes. It manifests as widespread infiltration, systemic signs of intoxication, fever, and impaired function of adjacent structures.
3. **Combined (associated) abscess and phlegmon** – the most aggressive clinical form involving both localized abscess formation and simultaneous spread of purulence into neighboring fascial spaces. This condition is particularly dangerous, as an abscess can become a secondary source of phlegmon, and conversely, a phlegmon may form discrete necrotic cavities resembling abscesses.

In the context of maxillofacial surgery, the combined form poses the greatest threat due to its overlap of localized and systemic features of severe infection. Delayed diagnosis or inadequate treatment significantly increases the risk of orbital, intracranial, and systemic complications. For this reason, early identification of the clinical-etiological form is essential for determining the appropriate therapeutic strategy.

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Diagnostics and Differential Diagnosis of Infraorbital Infections

Comprehensive and timely diagnostics of infraorbital inflammatory processes are crucial for preventing the progression and complication of the disease. A major challenge in diagnosing such conditions lies in the fact that early clinical symptoms may be nonspecific or subtle, complicating initial recognition and necessitating the use of a wide range of clinical and instrumental assessment tools.

Clinical evaluation should begin with an overall assessment of the patient's general condition, including the presence of fever, signs of intoxication, altered consciousness, and complaints of pain radiating to the orbit, temporal region, or zygomatic area. Physical examination frequently reveals facial asymmetry, swelling, and hyperemia of the skin over the infraorbital region, restricted facial expressions, and tenderness on palpation. A critical sign is the presence of an infiltrate with possible fluctuation and altered sensation in the distribution of the infraorbital nerve. In some cases, exophthalmos, restricted ocular mobility, tearing, and photophobia may be observed—indicating orbital involvement.

Intraoral examination plays a key role in identifying the primary odontogenic source. Attention should be paid to swelling of the vestibular fold, mucosal hyperemia, pain on palpation, percussion, and probing of the implicated teeth. The presence of periodontal pockets, fistulas, tooth mobility, and purulent discharge serve as additional diagnostic indicators.

Instrumental diagnostics include:

- **Computed Tomography (CT)** of the facial skeleton, considered the gold standard for visualizing maxillofacial infections. CT provides precise localization and volume of purulent lesions, assesses soft tissue involvement, bone condition, fractures, and sinus-orbital communication.
- **Ultrasound (US)** is useful at early stages and for superficial abscesses but has limited value in diagnosing deeper or combined infections.
- **Magnetic Resonance Imaging (MRI)** is primarily used in suspected intracranial complications or when CT is contraindicated. MRI offers superior soft tissue and orbital imaging.
- **Laboratory investigations** confirm systemic inflammation: leukocytosis, neutrophilic shift, elevated C-reactive protein, increased ESR, and in severe cases, signs of anemia, hypoproteinemia, and electrolyte imbalances.

Differential diagnosis must distinguish infraorbital infections from several clinically similar conditions:

- **Acute rhinosinusitis**, which may present with localized swelling and tenderness but lacks infiltration or fluctuation typical of abscess;
- **Orbital cellulitis**, distinguished by rapid ocular involvement, exophthalmos, diplopia, and vision impairment;

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- **Traumatic hematomas or infected abrasions**, which also cause swelling and pain but are usually associated with trauma history and lack systemic signs;
- **Facial soft tissue tumors** (benign or malignant), such as cysts or lipomas, which may mimic chronic inflammatory changes.

A comprehensive approach combining clinical, imaging, and laboratory data is essential to accurately differentiate abscesses, phlegmon, or their combination and to determine the anatomic extent and appropriate treatment strategy.

Modern Approaches to the Treatment of Infraorbital Infections

The treatment strategy for infraorbital infections is based on the severity of the patient's condition, the nature and extent of the inflammatory process, and the identified etiology. In the majority of cases, especially when a combined abscess and phlegmon is present, therapy must be urgent, comprehensive, and staged—encompassing surgical intervention, antimicrobial therapy, and detoxification support.

Surgical debridement is the mainstay, aiming to evacuate purulent material, reduce tissue pressure, and interrupt infection pathways. Depending on inflammation localization and infraorbital anatomy, different drainage approaches are used:

- **External access**, via an incision along the infraorbital rim (in a natural skin fold or subzygomatic line), ensures adequate exposure and prevents deeper orbital extension.
- **Combined approach**, involving both external and intraoral access, is particularly useful in odontogenic infections where the causative tooth must be removed and soft tissues debrided simultaneously.
- **Minimally invasive techniques**, such as aspiration or catheter drainage under ultrasound or CT guidance, may be suitable for small localized abscesses but are insufficient in phlegmonous cases.

Systemic antimicrobial therapy should be initiated empirically and then adjusted based on microbiological analysis of the purulent discharge. First-line agents include:

- **Third-generation cephalosporins** (e.g., ceftriaxone, cefotaxime);
- **Lincosamides** (e.g., lincomycin, clindamycin);
- **Metronidazole**, for anaerobic coverage;
- In severe cases, **carbapenems** (e.g., meropenem) or **combinations with fluoroquinolones** may be indicated.

Antibiotic efficacy is enhanced by **intravenous fluid therapy** with crystalloids, glucose, B-complex vitamins, detoxifying agents, and, when necessary, glucocorticoids in controlled doses. **Antihistamines and anticoagulants** are also essential, especially in cases with thrombotic or cavernous sinus involvement risk.

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Local treatment includes antiseptic irrigation via drains (e.g., dioxidine, chlorhexidine), hypertonic saline dressings, enzymatic therapy (e.g., hyaluronidase, trypsin), and physiotherapy during recovery (UHF, laser therapy, darsonvalization).

Eliminating the **primary infection source** is critical—usually by extracting the causative tooth or sanitizing the maxillary sinus. If sinusitis is suspected, an ENT consultation and potential maxillary sinus puncture or surgery may be necessary. In cases of orbital involvement or visual disturbance, urgent referral to an ophthalmologist and neurosurgeon is mandatory.

Thus, the treatment plan for infraorbital infections must be based on:

- Early diagnosis and hospitalization;
- Prompt drainage of purulent foci;
- Comprehensive antimicrobial and detox therapy;
- Multidisciplinary collaboration and ongoing monitoring.

The integrated application of these principles ensures favorable outcomes even in severe cases and prevents life-threatening complications.

Prevention and Multidisciplinary Coordination

Prevention of infraorbital infections is a critical component of comprehensive dental and surgical care, as timely elimination of primary infectious sources significantly reduces the risk of severe outcomes. Given that most cases are odontogenic in nature, routine oral hygiene, appropriate treatment of caries, chronic periodontitis, and high-quality endodontic and surgical procedures under strict aseptic conditions are vital.

Patients with immunodeficiencies, diabetes, oncological diseases, or those on long-term corticosteroid therapy are particularly at risk and require proactive monitoring and individualized prevention strategies.

Effective care also relies on a **multidisciplinary approach**, involving maxillofacial surgeons, dental therapists, ENT specialists, ophthalmologists, infectious disease experts, and, when needed, neurosurgeons. This collaborative model allows for early detection of complications and timely decisions on escalating treatment intensity or modifying surgical plans—especially relevant in aggressive combined abscess and phlegmon cases.

Further improvement is achievable through **optimization of clinical pathways**, **standardization of care protocols**, and the adoption of advanced diagnostic technologies such as **multislice CT**, **MRI**, and **rapid lab markers** (e.g., C-reactive protein, procalcitonin). These innovations reduce diagnostic time, minimize invasiveness, and improve surgical precision. The use of **digital navigation systems** and **3D visualization** tools also enhances planning and safety in complex interventions.

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In conclusion, infraorbital infections—particularly in their combined form—are extremely dangerous clinical entities requiring not only professional expertise but also a systematized organizational response. Integrated diagnostics, timely surgery, rational pharmacotherapy, and interdisciplinary collaboration are the pillars of effective treatment and prevention of orbital and intracranial complications. Establishing interprofessional clinical algorithms, implementing treatment standards, and advancing specialist training are essential to improving the quality of maxillofacial surgical care

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