Review

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Orbital Consequences of Chronic Rhinosinusitis: A Contemporary Narrative Review of the Ophthalmologic Impact and Therapeutic Role of Functional Endoscopic Sinus Surgery

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Orbital Consequences of Chronic Rhinosinusitis: A Contemporary Narrative Review of the Ophthalmologic Impact and Therapeutic Role of Functional Endoscopic Sinus Surgery

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Abstract

Chronic rhinosinusitis (CRS) is a prevalent inflammatory condition of the paranasal sinuses involving at least 12 weeks of persistent sinonasal inflammation, often with nasal obstruction, discharge, facial pressure, and hyposmia. While the burden of CRS on quality of life and respiratory health is well recognized, its potential impact on orbital structures is an area of growing clinical attention. Chronic sinus disease can therefore extend beyond the sinuses to involve the orbit, leading to ophthalmologic complications that range from subtle vision changes to severe, sight-threatening emergencies. Traditionally, orbital complications are more commonly associated with acute sinusitis (particularly in children), but contemporary evidence highlights that chronic rhinosinusitis and its sequelae – including mucoceles, chronic infections (bacterial or fungal), and protracted inflammation – can likewise produce significant orbital consequences. These manifestations underscore the need for vigilance and a multidisciplinary approach in managing CRS patients with ocular symptoms. This review aims give an updated understanding of this interdisciplinary topic to clinicians in both otolaryngology and ophthalmology, guiding prompt recognition and effective management of CRS patients with orbital involvement.

Keywords: crs; FESS; orbit; complications; rhinology; ophthalmology

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Introduction

Chronic rhinosinusitis (CRS) is a prevalent inflammatory condition of the paranasal sinuses, affecting an estimated 5–12% of the population worldwide [1]. By definition, CRS involves at least 12 weeks of persistent sinonasal inflammation, often with nasal obstruction, discharge, facial pressure, and hyposmia [2]. While the burden of CRS on quality of life and respiratory health is well recognized, its potential impact on orbital structures is an area of growing clinical attention. The orbit, which houses the eye and its adnexa, is separated from the ethmoid and frontal sinuses by only thin bony laminae. Chronic sinus disease can therefore extend beyond the sinuses to involve the orbit, leading to ophthalmologic complications that range from subtle vision changes to severe, sight-threatening emergencies [3]. Traditionally, orbital complications are more commonly associated with acute sinusitis (particularly in children) [3], but contemporary evidence highlights that chronic

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rhinosinusitis and its sequelae – including mucoceles, chronic infections (bacterial or fungal), and protracted inflammation – can likewise produce significant orbital consequences [4]. These manifestations underscore the need for vigilance and a multidisciplinary approach in managing CRS patients with ocular symptoms.

The otorhinolaryngological cornerstone for dealing with these conditions is the Functional endoscopic sinus surgery (FESS). FESS is a minimally invasive surgical technique which has revolutionized the management of chronic rhinosinusitis and its complications reopening obstructed sinus pathways, allowing drainage and ventilation of the sinuses while preserving normal structures [5,6]. In the context of orbital complications, FESS serves not only to alleviate sinus disease but also as a therapeutic tool to decompress orbital structures, drain abscesses, remove expansile lesions, and ultimately protect visual function. In recent years (2020–2025), numerous studies and case series have detailed the ophthalmologic outcomes of patients with CRS-related orbital involvement and the role of timely FESS in their management [7]. This narrative review synthesizes the current literature on the orbital consequences of chronic rhinosinusitis, highlighting clinical, relevant anatomical/pathophysiological pathways, preoperative versus postoperative findings, and the therapeutic impact of FESS. We focus exclusively on human studies across all ages and immunologic statuses, and emphasize the importance of multidisciplinary care (ENT, ophthalmology, and others) in optimizing outcomes. Through this review, clinicians in both otolaryngology and ophthalmology can gain an updated understanding of this interdisciplinary topic, guiding prompt recognition and effective management of CRS patients with orbital involvement.

Anatomical Relationships Between Sinuses and Orbit

Considering that more than 60% of the bony orbital wall area borders the paranasal sinuses [3] is fundamental to understanding how chronic sinus disease can affect the eyes. More. The ethmoid sinuses are separated from the orbit by the lamina papyracea – a paper-thin bone forming the medial orbital wall [8]. Likewise, the roof of the maxillary sinus forms the orbital floor, and the frontal sinus lies just superior to the orbital roof. This intimate adjacency means that inflammatory or expansile processes in the sinuses can readily impinge upon orbital contents. The orbit itself is a rigid compartment with limited capacity to absorb expanding masses or edema; any rise in intraorbital pressure (such as from an abscess or mucocele) cannot easily dissipate except anteriorly (by pushing the globe forward) [3]. As a result, even gradual sinus pathology can eventually lead to proptosis (eye protrusion) or compressive neuropathy within the orbit.

Several anatomical pathways facilitate the spread of disease from sinuses to orbit. The lamina papyracea may be congenitally dehiscent or eroded by chronic inflammation, providing a direct route for sinus pathology to enter the orbit [9]. Computed tomography studies show lamina papyracea dehiscence in a small percentage of individuals (around 2–10%, varying by population) [10] and any such defect exposes the orbit to sinus-derived infection or polyposis. Even when the bony partition is intact, infection can extend via valveless venous channels between the ocular adnexa and sinus mucosa [11]. The ophthalmic venous system lacks valves, so septic thrombophlebitis from the sinuses can propagate into orbital veins, as is suspected in cases of cavernous sinus thrombosis or diffuse orbital cellulitis. Additionally, certain posterior ethmoid cells (Onodi cells) lie in close proximity to the optic nerve; an inflammatory lesion or mucocele in an Onodi cell can directly compress the optic nerve through the thin bony canal [12]. The sphenoid sinus, though less commonly involved in CRS, also neighbors critical structures: the optic nerves, ophthalmic artery, and cranial nerves III, IV, V1/V2, and VI run in or near the sphenoid walls. Thus, a sphenoid sinus mucocele or fungal ball can invade on these structures, causing optic neuropathy or cranial neuropathies (ophthalmoplegia or trigeminal sensory loss) [13]. In summary, the thin osseous barriers and shared neurovascular conduits create potential "weak points" where chronic sinus inflammation can breach into the orbit.

Pathophysiological Relationships Between Chronic Rhinosinusitis and the Orbit

Several mechanisms can affect both entities in vice versa pattern (Figure 1).

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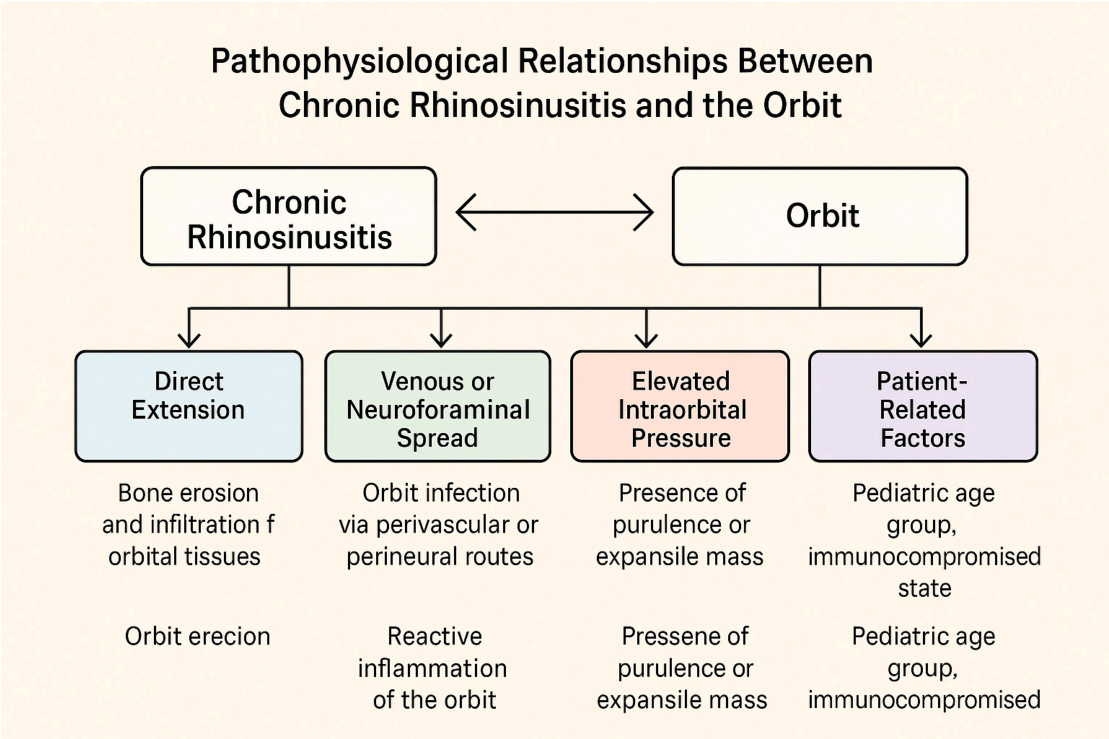

Figure 1.

- **Direct Extension**: Prolonged inflammation may lead to bone erosion. For example, an expanding sinus mucocele produces pressure necrosis of bony walls, eventually protruding into the orbit as a cystic mass [13,14]. Similarly, chronic granulomatous infections (like invasive fungal sinusitis) can destroy bones and infiltrate orbital tissues.
- **Venous or Neuroforaminal Spread**: Bacteria from chronic sinusitis can travel along perivascular or perineural planes. Chronic bacterial sinusitis is less commonly associated with orbital cellulitis than acute sinusitis, yet acute exacerbations of CRS can precipitate orbital infection via these pathways [3]. In particular, the valveless veins [15] connecting the ethmoid sinus and orbital contents (e.g. via the superior ophthalmic vein) provide a route for infection, which can result in an inflammatory thrombosis that increases intraorbital pressure.
- **Immune-Mediated Inflammation**: Chronic inflammatory conditions in the sinuses (such as allergic fungal rhinosinusitis or eosinophilic mucin rhinosinusitis) may cause reactive inflammation in adjacent orbital tissues even without overt bone erosion. The intense allergic mucin of allergic fungal sinusitis (AFS) can induce local bone remodeling and periosteal inflammation, effectively "spilling over" into the orbit [4] Patients with AFS often have remodeling of the lamina papyracea; when orbital periosteum is involved, a chronic inflammatory response in the orbit can mimic an idiopathic orbital inflammatory syndrome.
- **Elevated Intraorbital Pressure**: Regardless of how orbital involvement occurs, once purulent material or expansile mass is present in the orbital or subperiosteal space, pressure within the orbital compartment rises. The orbit's inelastic walls and tough fibrous septum limit outward expansion, so significant swelling leads to a compartment syndrome [16]. Clinically, this manifests as a "tense" or proptotic eye with rock-hard orbit on palpation, and the optic nerve and ocular muscles may be compressed [3]. If not promptly relieved, such pressure can cause ischemic optic neuropathy. An understanding of this dynamic informs the urgency of surgical

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decompression in certain cases (e.g. an orbital abscess causing vision loss is an ophthalmologic emergency).

- **Patient-related factors:** Importantly, individual parameters influence the propensity for orbital complications. Pediatric patients are uniquely vulnerable: their craniofacial bones are still developing, and the ethmoid sinuses (present at birth) are separated from the orbit by an even thinner lamina than in adults. This partly explains why orbital complications historically occur more in children (who often suffer acute ethmoiditis leading to orbital cellulitis). On the other end of the spectrum, immunocompromised individuals (including those on chronic corticosteroids or with uncontrolled diabetes) are prone to invasive fungal sinusitis, which can rapidly traverse orbital boundaries via angioinvasion [17]. Indeed, a recent study on isolated sphenoid rhinosinusitis found that orbital complications were significantly more common in patients with comorbid diabetes or malignancy, or where CT imaging showed bony dehiscence of sinus walls [18]. Taking together, these anatomic and pathophysiologic considerations illustrate why the orbit is at risk in CRS and set the stage for the clinical sequelae discussed next.

Ocular Manifestations of Chronic Rhinosinusitis

When chronic rhinosinusitis extends to involve orbit, patients can present with a variety of ophthalmic signs and symptoms. These ocular manifestations often develop insidiously in CRS, unlike the abrupt presentations in acute sinusitis. Nevertheless, they should raise concern for a sino-orbital process, especially in a patient with known sinus disease. Key ophthalmologic manifestations include:

- **Proptosis (Exophthalmos)**: Forward protrusion of the eyeball is a common sign of orbital involvement in chronic sinus disease. It results from mass effects or increased orbital pressure. For instance, an ethmoid or frontal mucocele gradually expanding into the orbit will push the globe outward. In a 2023 series of 64 patients with chronic rhinosinusitis and orbital complications, proptosis was the most frequent presenting sign [19]. Similarly, allergic fungal sinusitis often causes unilateral proptosis due to expansive allergic mucin eroding the orbital wall [20]. Proptosis may be accompanied by globe displacement in a particular direction (e.g. lateral or inferior displacement from a medial wall lesion). Chronic processes classically cause a non-axial, gradual proptosis without the acute inflammatory signs of redness or severe pain. Long-standing proptosis can lead to exposure keratopathy if the eyelids cannot fully cover the eye. Fortunately, proptosis caused by CRS tends to improve after appropriate sinus surgery and drainage of the causative lesion. Reports have documented dramatic reduction of proptosis after FESS for AFRS and mucoceles [21]. Moreover, even bony orbital expansion can partially reverse: Lee et al. (2020) described that bony remodeling of the orbit from AFRS regressed after complete FESS and corticosteroid therapy [21]
- **Diplopia and Ophthalmoplegia**: Diplopia (double vision) in CRS patients signals extraocular muscle dysfunction or cranial nerve involvement, often due to orbital extension. Chronic ethmoid sinusitis with erosion can form a subperiosteal abscess that mechanically restricts the medial rectus muscle, or an inflammatory reaction that impairs muscle movement [3]. Patients may complain of horizontal diplopia if the lateral or medial rectus is affected, or vertical diplopia if the superior or inferior rectus is involved. In the context of sphenoid sinus disease, cranial nerves III, IV, and VI running in the cavernous sinus or superior orbital fissure may be compressed by mucoceles or invasive fungus, leading to ophthalmoplegia (paralysis of eye movements) [13]. A sphenoid mucocele, for example, can present with an isolated lateral rectus

palsy (VI nerve), leading to acute diplopia which resolved after endoscopic sphenoid mucocele marsupialization [13]. In chronic processes, diplopia might be intermittent or subtle initially (e.g. only on gaze to one side) and can progressively worsen. On examination, limitation of ocular motility is a key finding; Tadros et al. (2023) noted that restricted eye movements were a common feature alongside proptosis in CRS patients with orbital complications [19]. Notably, in an 11-patient series of orbital mucoceles, 54.5% had diplopia and motility limitation at presentation [22]. Encouragingly, diplopia due to sino-orbital lesions, often improves after surgical intervention. By draining the abscess or removing the mucocele via FESS, pressure on the extraocular muscles is relieved. In the Turkish series on orbital mucoceles, all patients experienced improvement in eye movement and resolution of diplopia after surgery [22]. However, if chronic compression caused muscle fibrosis or nerve damage, residual diplopia [23] may persist, underscoring the importance of timely treatment.

- **Orbital Pain and Pressure**: Pain is an important symptom that can herald orbital involvement in CRS. Unlike the dull facial pressure typically felt with sinusitis, orbital pain is often sharper or felt behind the eye and may worsen with eye movement if the periocular tissues or optic nerve sheath are inflamed [11]. Patients might describe a deep retro-orbital ache. In chronic sinusitis, pain can result from an expanding lesion stretching the periosteum (which is well innervated) or from inflammatory involvement of the orbital nerves. Invasive fungal sinusitis, for example, frequently causes severe orbital and facial pain due to perineural spread and tissue necrosis. In a study of COVID-19–associated mucormycosis (an acute invasive fungal CRS), 79% of patients had orbital/facial pain as a presenting symptom [17]. Chronic indolent processes like mucocele can also cause progressive orbital discomfort; patients may not feel pain until the lesion reaches a critical size or causes nerve compression. Periorbital tenderness and headaches often accompany sphenoid sinus lesions that affect the orbital apex. Headache and retro-orbital pain [24] were noted to be significantly more frequent in sphenoid CRS patients who developed orbital complications than in those who did not [18], indicating that pain can be a warning sign of deeper invasion. From a pathophysiologic perspective, pain on eye movement (especially upward gaze) suggests involvement of the superior rectus or optic nerve sheath (as seen in orbital apex syndrome). Any CRS patient who reports new eye pain or painful ophthalmoplegia should be evaluated urgently with imaging for a possible subperiosteal abscess or apical process. Relief of pain after surgical drainage or decompression is often impressive; patients frequently note that a deep pressure is relieved as pus is evacuated. Persistent pain postoperatively is concerning and may indicate residual infection or compartment syndrome needing further intervention.
- **Visual Disturbances (Vision Loss, Blurred Vision)**: Perhaps the most critical ophthalmologic consequence of chronic rhinosinusitis is impaired vision. Vision changes may range from slight blurring or intermittent obscuration to frank vision loss in the affected eye [25]. There are several mechanisms for vision loss in this context: compressive optic neuropathy, ischemic optic neuropathy from elevated orbital pressure, direct optic neuritis from contiguous inflammation, or invasive destruction of optic nerve fibers by infection. One classic scenario is a sphenoid sinus mucocele or posterior ethmoid mucocele compressing the optic nerve. Patients might notice dimming of vision or a visual field defect (often unilateral) that progresses over day to weeks [12]. Unfortunately, chronic compressive optic neuropathy can become irreversible if not relieved promptly. A case report of an Onodi cell mucocele (a trapped posterior ethmoid

mucocele) illustrated this risk: a 29-year-old woman had 20 days of progressive vision loss leading to complete blindness in that eye by 12 days before surgery; despite urgent endoscopic decompression, the vision could not be restored, likely because of prolonged optic nerve compression [12].

- **Other ocular findings:** Periorbital swelling and erythema are common, especially if an abscess or significant inflammation is present in the orbit [19]. Chronic sinusitis itself usually does not cause external redness, so new-onset eyelid edema or conjunctival chemosis in a CRS patient should prompt imaging for a concealed subperiosteal abscess or orbital cellulitis. Chemosis (conjunctival edema) and venous engorgement in the orbit indicate impaired venous drainage, often seen in advanced orbital apex syndrome or cavernous sinus involvement [3]. Ptosis (drooping of the upper eyelid) may occur due to a third nerve palsy or sympathetic nerve involvement (Horner syndrome) if the cavernous sinus is affected – Chang et al. noted ptosis among the orbital complications in isolated sphenoid sinusitis [18]. Epiphora (excess tearing) can result if the nasolacrimal duct is obstructed by chronic ethmoid inflammation [26] or polyps, though this is more of a nasolacrimal complication than orbital proper. In long-standing cases of silent sinus syndrome (a chronic maxillary sinus atelectasis), patients develop enophthalmos (sunken eye) and hypoglobus due to collapse of the orbital floor – this is an unusual orbital consequence where the eye moves inward rather than protruding. Silent sinus syndrome patients present with cosmetic asymmetry or vertical diplopia, and their condition is reversed by re-aerating the sinus with FESS (and sometimes repairing the orbital floor) [27]. Indeed, some surgeons managing silent sinus syndrome forgot immediate orbital floor reconstruction [28] because re-establishing sinus aeration via endoscopic surgery alone can significantly improve the enophthalmos and diplopia over time [27].

In summary, chronic rhinosinusitis can produce a wide spectrum of ocular symptoms which often overlap – for example, a patient with an ethmoid mucocele may have proptosis with diplopia and some ache behind the eye. The presence of any of these signs should prompt thorough evaluation for orbital involvement of sinus disease. A careful history (sinus symptoms, nasal obstruction, prior sinus surgeries) and targeted imaging (contrast-enhanced CT or MRI of sinuses and orbits) help confirm a sino-orbital diagnosis [11]. The clinician must differentiate these symptoms from those caused by primary ophthalmologic disorders.

Clinical Spectrum of Orbital Complications in Chronic Rhinosinusitis

Chronic rhinosinusitis can produce an array of orbital complications, from benign-appearing proptosis due to a mucocele to fulminant fungal invasion causing complete ophthalmoplegia and vision loss. Awareness of these possibilities is crucial for any clinician managing CRS. Prompt imaging and referral to specialists (ophthalmology and otolaryngology) can ensure that these complications are recognized early and treated appropriately.

Orbital complications of chronic rhinosinusitis can be classified by etiology and anatomical patterns. Unlike acute sinusitis where the Chandler classification [29] (preseptal cellulitis, orbital cellulitis, subperiosteal abscess, orbital abscess, cavernous sinus thrombosis) is commonly used, chronic cases often present as more indolent processes such as chronic abscesses, mucocele formation, or invasive granulomatous disease.

- **Subperiosteal Abscess and Chronic Orbital Cellulitis:** Recurrent or inadequately treated sinus infections can lead to a persistent subperiosteal abscess on the orbital wall. This is essentially a localized collection of pus between the lamina papyracea and the orbital periosteum. While subperiosteal abscess (SPA) is classically a complication of acute ethmoiditis in children, it can occur in chronic sinusitis as well – often in the setting of acute exacerbation of CRS or chronic osteomyelitis of the lamina. Tadros et al. reported 28 patients with subperiosteal abscess out of 64 CRS orbital cases (44%) [19], underscoring that this entity is not confined to acute sinusitis. Chronic SPAs may develop a thick fibrous wall and can smolder for weeks, sometimes with less acute illness. Patients might have low-grade fevers or just localized swelling and double vision. Imaging (CT) will show a rim-enhancing collection adjacent to the medial orbit. These abscesses raise intraorbital pressure and can threaten vision if they enlarge and push on the optic nerve. They may also breach inward to become orbital abscesses. Chronic orbital cellulitis refers to a persistent, diffuse infection in orbital tissues – it's rarer, but can occur especially in immunosuppressed individuals or with indolent organisms like *Pseudomonas* or *Mycobacteria*. Any suspicion of a subperiosteal abscess or chronic post-septal cellulitis in CRS warrants surgical drainage in most cases, as antibiotics alone often fail due to biofilm and sequestered pus [3]. Endoscopic drainage of SPAs (ethmoidectomy) is the preferred approach, allowing direct evacuation of pus and sinus irrigation. Notably, early surgical drainage yields good outcomes: vision typically returns to normal, and diplopia resolves in the majority of cases post-drainage. In children with small SPAs, a trial of high-dose antibiotics can be considered, but many chronic cases eventually need FESS to prevent recurrence. Interdisciplinary management is crucial as ENT surgeons address the infection source, ophthalmologists monitor the optic nerve and ocular perfusion during treatment.

- **Mucocele with Orbital Extension:** Mucoceles are a hallmark complication of chronic rhinosinusitis, especially in patients with long-standing obstruction of a sinus outflow. A mucocele is a mucus-filled, epithelial-lined cystic structure that results from chronic blockage of a sinus ostium. Over time, trapped mucus accumulates and the expansile lesion causes thinning and bulging of surrounding bone. The frontal sinus is most affected (accounting for ~60–65% of mucoceles), followed by ethmoid sinus (25–30%) [12]. When these mucoceles expand, they frequently extend into the orbit due to erosion of the thin orbital walls. Frontal mucoceles tend to push down into the orbit causing an anterior globe displacement (sometimes with an inferolateral dystopia), whereas ethmoid mucoceles push laterally on the medial orbit. Patients often present with progressive, painless proptosis or orbital deformity. Diplopia can occur if the mass compresses an extraocular muscle. In a retrospective analysis of 11 patients with intraorbital mucoceles, proptosis was present in 64% and diplopia in 55% [30]. The mucocele origins were frontal (55%), ethmoid (27%), and maxillary (18%), reflecting that any sinus can cause an orbital mucocele [30]. Less commonly, sphenoid sinus mucoceles extend to the orbital apex and cause visual loss or isolated cranial nerve palsies without obvious external proptosis [6]. Imaging is diagnostic: CT shows an expansile, opacified sinus with bony thinning, while MRI can differentiate the mucocele content (often showing homogeneous mucus signal). The definitive treatment for sinus mucoceles is surgical marsupialization – essentially, creating a wide opening endoscopically for the mucocele to drain into the nasal cavity [6,12]. FESS technique is highly effective for this; an endonasal endoscopic approach can unroof frontal or ethmoid mucoceles and re-establish normal sinus drainage. According to a case series of 10 patients with intraorbital or intracranial extending mucoceles, endoscopic sinus surgery achieved symptom resolution with minimal complications and no recurrences in all cases [31]. This highlights that even extensive mucoceles can be managed successfully via FESS, sometimes combined with image-guidance for safety. Only in scenarios where the mucocele is inaccessible endoscopically (e.g. far lateral frontal sinus) might an external approach (like an osteoplastic flap) be added [30]. After marsupialization, the orbit usually decompresses on its own as the cyst shrinks. Regular postoperative endoscopy and saline irrigations help prevent re-obstruction of the drainage opening.

- **Allergic Fungal Rhinosinusitis (AFRS) with Orbital Invasion:** Allergic fungal rhinosinusitis is a form of chronic sinusitis characterized by an intense eosinophilic immune response to colonizing fungi in the sinuses (often *Aspergillus* or dematiaceous molds). AFRS typically causes nasal polyps and the accumulation of allergic mucin (thick, peanut butter–like mucus with fungal debris) within the sinuses [4]. Patients are usually atopic young adults and immunocompetent. The expansile nature of allergic mucin can cause bony erosion similar to a mucocele, except that in AFRS multiple sinuses are often involved and the material can be very polyposis laden. Ophthalmic manifestations are relatively common in advanced AFRS [4]. Unilateral proptosis is the most frequent, as noted in case reports and small series [32]. Other reported features include telecanthus (widening of the distance between medial canthi due to ethmoid expansion), hypertelorism, malar flattening from maxillary sinus expansion, and even dystopia of the globe [4]. Diplopia and decreased vision can occur if AFRS involves the orbital apex or compresses the optic nerve – though true optic neuropathy is less common in AFRS than in invasive fungal disease. A striking example is a published case of extensive AFRS in a 35-year-old male that led to bilateral proptosis and frontal bone remodeling; despite the dramatic appearance, his vision remained intact and the ocular changes reversed after treatment. On CT, AFRS classically shows heterogenous sinus opacification with serpiginous areas of calcification (from allergic mucin) and bony remodeling of sinus walls [21]. The orbit may show an expanded contour but usually no discrete abscess. The mainstay of therapy is combined surgical and medical management: FESS to remove all fungal mucin and polyps, followed by systemic and topical corticosteroids to reduce inflammation and prevent recurrence [4]. Endoscopic surgery in AFRS can be extensive, often requiring opening of every affected sinus (maxillary, ethmoid, sphenoid, frontal) and drainage of any orbital extension. Postoperatively, patients often have remarkable improvement in proptosis and orbital alignment as the immune reaction subsides [7]. One case report specifically noted that even bony orbital changes from AFRS were reversible with adequate surgical treatment [7]. AFRS has a high recurrence rate if any fungal antigen remains – hence meticulous surgical clearance and long-term steroid irrigations are important. From an ophthalmologic standpoint, AFRS underscores how a non-invasive (but inflammatory) process can nonetheless threaten orbital structure and function, necessitating the collaboration of allergists, ENT surgeons, and ophthalmologists in care.
- **Invasive Fungal Sino-Orbital Infection:** In immunocompromised or immunosuppressed patients, chronic sinusitis can be caused by invasive fungi that progressively destroys tissue. Chronic invasive fungal rhinosinusitis (CIFR) is typically seen in diabetics, transplant recipients, long-term steroid users, or other immunocompromised states. It contrasts with allergic fungal sinusitis by featuring true tissue invasion by fungal hyphae, often without the dramatic allergic mucin. Depending on the pathogen and host immunity, invasive fungal sinusitis can run a subacute course (weeks to months, e.g. with *Aspergillus* in a mild immunosuppression) or a fulminant course (days, e.g. *Mucor* species in poorly controlled diabetic ketoacidosis or in COVID-19-associated cases) [17]. The orbit is frequently involved because these fungi tend to invade blood vessels and nerves, which lead to the orbit and cranial cavity. *Mucormycosis* of the

sinuses (also known as rhino-orbital-cerebral mucormycosis) became a notable orbital complication during the COVID-19 pandemic, where numerous cases were reported in patients with COVID-related steroid use and diabetes [33]. Clinically, invasive fungal sinusitis often presents severe orbital or facial pain, ophthalmoplegia, rapid vision loss, and black necrotic tissue in the nasal cavity. There may be relative lack of fever or pus despite extensive tissue necrosis. On exam, a pale or anesthetic face with eschar (black dead tissue) on the turbinates strongly suggests mucormycosis. Radiologically, one might see sinus opacification with bone destruction and even intraorbital fat stranding or abscess. The urgency of this condition cannot be overstated: it is a true medical and surgical emergency with high mortality if not treated immediately. Treatment requires a multidisciplinary and aggressive approach: surgical debridement (typically via extensive FESS and often external approaches for orbital or cranial debridement) combined with systemic antifungal therapy (e.g. liposomal Amphotericin B) [17]. In many cases of rhino-orbital mucormycosis, orbital exenteration (removal of the eye and orbital contents) may be performed if the infection overwhelms the orbit, in order to save the patient's life. However, recent series have aimed for globe-sparing surgery when possible. For example, Arunkumar et al. [17] reported on 42 patients with COVID-associated mucormycosis all managed with FESS plus IV antifungals; only 10.5% ultimately required exenteration, and the overall survival was 97.6%. Those who retained their eye often had some degree of vision impairment, but early surgical decompression led to favorable outcomes in a significant number. Another multi-center Indian study similarly found that combined sinus debridement and medical therapy yielded a ~60% favorable outcome, though cases with orbital apex involvement had worse visual prognosis [34]. Chronic invasive fungal sinusitis (such as invasive aspergillosis in an immunocompetent host) can present more subtly – maybe just unilateral proptosis and diminished vision over months. These two require surgical and medical treatment, albeit with perhaps less urgency than mucor. Any form of invasive fungal orbitopathy is best managed with a team: ENT surgeons to operate disease, ophthalmologists to assess eye viability and possibly administer adjuncts like retrobulbar Amphotericin B injections [35], and infectious disease specialists to guide antifungal therapy. The prognosis for vision in invasive fungal sinusitis is guarded – invasive disease was the one category in Tadros et al.'s CRS series where ophthalmologic manifestations were *not* fully reversible [19]. Still, with rapid intervention, some patients can survive with intact vision or minimal deficit if the infection is halted early. This category highlights the extreme end of the spectrum of CRS orbital complications – where life and sight are imminently at risk, demanding the highest level of multidisciplinary care.

- **Miscellaneous and Rare Complications:** A few other orbital consequences merit brief mention. Chronic bacterial sinusitis occasionally leads to orbital apex syndrome [36] – a combination of ophthalmoplegia (CN III, IV, VI palsies) and optic nerve dysfunction due to inflammation in the very back of the orbit. This can occur from a sphenoid sinus infection or granulomatous inflammation (e.g. sarcoidosis or Wegener's granulomatosis in the sinus spreading to the orbital apex). Treatment is tailored to the cause (e.g. antibiotics for bacteria, immunosuppression for granulomatous disease, plus surgical decompression if needed). Another potential issue is nasolacrimal duct obstruction from CRS, particularly in chronic maxillary sinusitis or after sinus surgery scarring [37,38]– while technically not an orbital complication, it is an ophthalmologic outcome that might require dacryocystorhinostomy to restore tear drainage. Orbital emphysema can result from forceful nose blowing in patients with an existing lamina papyracea defect [39], leading to air forced from the sinus into the orbit; this typically causes transient swelling and crepitus and is managed conservatively unless vision is compromised (rare) [3]. Finally, chronic osteitis of the orbital bones from longstanding sinusitis [40]can cause a dull ache and thickening of bone (e.g. sclerosing osteitis of the ethmoid); this is more an imaging finding and usually resolves after the sinus disease is treated.

Evaluation and Multidisciplinary Management

The evaluation of a patient with suspected orbital involvement from chronic rhinosinusitis requires a coordinated approach. Imaging is paramount: a contrast-enhanced CT scan of the sinuses and orbits is typically the first-line study, as it delineates bony anatomy and can identify abscesses, mucoceles, and bone erosion with high resolution [11,41]. CT is excellent for surgical planning as well, showing any dehiscence in the lamina papyracea or optic canal. Magnetic resonance imaging (MRI) provides complementary information, especially in cases of suspected fungal disease or intracranial extension. MRI can distinguish inflammation from abscess and identify optic nerve or dural enhancement that might not be clear on CT [42]. In practice, if vision loss or cavernous sinus thrombosis is a concern, CT is done emergently to guide sinus surgery, and MRI can follow for detailed brain/orbit evaluation. Ophthalmologic examination is the other cornerstone of evaluation. A comprehensive eye exam should assess visual acuity, pupillary responses (look for RAPD- Relative afferent pupillary defect [43]), extraocular movements, proptosis measurement (exophthalmometry), lid position, color vision, and visual fields if possible. Baseline documentation of these parameters is crucial, as they guide urgency (e.g., any optic nerve dysfunction is a red flag) and serve as a comparison after treatment. Ophthalmologists may also perform ocular ultrasonography in certain scenarios (for example, to distinguish orbital abscess vs. cellulitis if imaging is delayed, or to check for central retinal artery pulsations in orbital compartment syndrome). However, imaging is generally more definitive in sinus-related cases. Laboratory tests can be useful adjuncts: a CBC might show leukocytosis in infection, inflammatory markers (ESR, CRP) could be elevated, and in suspected mucormycosis, checking blood glucose and iron studies is important due to the link with diabetic ketoacidosis and iron overload. Microbiological testing (e.g. fungal stain/culture, bacterial culture) is usually obtained during surgical drainage rather than beforehand, unless a conjunctival swab or biopsy of an exposed orbital lesion is feasible.

Once the extent of disease is characterized, an individualized management plan is formulated. The mainstay of therapy for most CRS-related orbital complications is aggressive medical therapy combined with timely surgical intervention. In milder cases without abscess or threatened vision, a trial of medical management can be attempted: this includes broad-spectrum antibiotics (or targeted antibiotics if culture data from sinuses exist) to cover typical sinus pathogens, systemic corticosteroids to reduce inflammation and edema, nasal saline irrigations, and decongestants. For example, a patient with moderate orbital edema and limited motility from chronic ethmoiditis but no abscess might be managed with antibiotics and observation in hospital for 24-48 hours. Close monitoring by both ENT and ophthalmology teams is mandatory during this period; any worsening or lack of improvement triggers surgical drainage. In invasive fungal cases, medical management means antifungal therapy (amphotericin B, posaconazole, etc.) started as soon as possible, often even before surgery given the urgency [17]. Conversely, in mucocele or AFRS, medical therapy (like steroids) alone will not resolve the orbital effect – surgery is usually needed, with medical therapy playing a supportive role (e.g. steroids post-op to prevent recurrence of polyps in AFRS).

Functional Endoscopic Sinus Surgery

FESS is the cornerstone of surgical management in these cases having a pivotal role on treating and preventing orbital consequences. The goals of FESS in orbital complications are to relieve pressure, eradicate infection, and remove any pathological tissue causing orbital compression. In essence, the endoscope allows the surgeon to directly address the problem through the nasal cavities without external incisions. In an orbital abscess scenario, the ENT surgeon can make an incision in the lamina papyracea from inside the nose and drain pus from the subperiosteal space, all under endoscopic view. This approach has largely replaced older external techniques (like Lynch incisions or Caldwell-Luc) for medial orbital abscesses, as it avoids facial scars and enables simultaneous sinus clearance [44,45]. FESS has proven safe and effective even in pediatric patients with orbital complications, with high success in resolving infection and low complication rates when performed by experienced surgeons [46]. Image-guidance (using CT navigation) [47] is often employed during these cases because distorted anatomy from disease can increase surgical risk.

The results of surgical intervention in CRS-related orbital disease are generally favorable. Multiple contemporary studies have documented high rates of visual and ocular motor recovery after prompt FESS. For instance, an analysis of orbital infections noted that after endoscopic sinus surgery, visual acuity improved or stabilized in all patients who had preoperative impairment [46]. In another series of sphenoid sinusitis with orbital complications, surgical treatment prevented further vision loss in the majority and allowed cranial nerve palsies to gradually recover over weeks [18]. The earlier the surgery, the better the outcomes: delaying intervention in an abscess or compression situation can lead to permanent deficits. Early endoscopic sinus surgery has even been advocated in some cases of orbital cellulitis that traditionally might be managed medically, as evidence suggests it can shorten hospital stay and antibiotic duration with equal or better outcomes [48]. The decision to operate is based on clinical stage: any signs of orbital abscess, optic nerve compromise (decreased vision or +RAPD), or lack of improvement on maximal medical therapy are clear indications for urgent surgery.

The multidisciplinary nature of care cannot be overstated. Interdisciplinary collaboration between otolaryngologists and ophthalmologists should be in place from the time of admission or evaluation [3] ENT surgeons focus on treating the source (the sinuses) and performing surgery, while ophthalmologists monitor and manage the ocular aspects – for example, measuring intraocular pressure, considering optic nerve protection measures, and post-op eye care. In severe orbital compartment syndrome, an ophthalmologist might perform a lateral canthotomy and cantholysis at the bedside to immediately reduce pressure while ENT prepares for sinus surgery. Pediatric cases benefit from involvement of pediatricians or pediatric infectious disease specialists to optimize antibiotics and general care. Radiologists are key players too: their prompt interpretation of imaging and sometimes intraoperative navigation assistance contribute to surgical precision. In invasive fungal cases or those with intracranial extension, neurosurgeons may be consulted to help manage cavernous sinus thrombosis or brain abscess, and neurologists may assist in monitoring cranial neuropathies. These complex patients might be discussed in multidisciplinary meetings or co-managed on combined services. Trbojević et al. [49] presented an exemplary model in which a team of pediatric ENT surgeons, ophthalmologists, and pediatricians worked jointly in managing children with orbital cellulitis, resulting in efficient care and good outcomes [49]. The same principles apply to adult care, especially with regard to coordinated decision-making about surgery timing and critical care support if needed.

From the ophthalmology side, supportive care measures are also important. Lubricating eye drops or ointment protect the cornea in proptosis or lagophthalmos. If optic neuropathy is suspected, some protocols include high-dose systemic corticosteroids to reduce optic nerve inflammation and edema (particularly in idiopathic orbital inflammatory conditions or in combination with surgical decompression for optic nerve compression). However, in the setting of infection, steroids are used cautiously and typically only after surgical source control, to avoid exacerbating the infection. For example, in mucormycosis, steroids are contraindicated; but in an inflammatory edema causing optic nerve compression without infection, a short course of steroids alongside surgery may be beneficial [12].

After surgical intervention, close follow-up is necessary. Ophthalmologic exams are repeated to ensure improvement or at least stabilization of vision and eye movements. In nearly all reported cases, if the intervention is successful, ocular signs improve postoperatively. In the Egyptian series

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on CRS orbital complications, all ophthalmologic manifestations were reversible after treatment except in those with invasive fungal disease [19]. That means symptoms like proptosis, diplopia, and even reduced vision improved back to baseline in most patients once the underlying sinus issue was resolved. This emphasizes how effective time management can be. ENT follow-up with endoscopic examinations and debridements in the weeks following FESS is also key to ensuring proper sinus healing and reducing the risk of disease recurrence that could again affect the orbit. In certain chronic conditions like AFRS, ongoing medical therapy (nasal steroids, allergy management) continues for months to years to prevent relapse.

Preoperative vs Postoperative Ophthalmologic Outcomes

It is instructive to compare the ophthalmologic status of patients before and after FESS for CRS orbital complications, to appreciate the impact of intervention. Prior to treatment, many patients have significant deficits: for example, Chowdhury et al. noted that in their cohort of patients with orbital/intracranial mucoceles, symptoms ranged from periorbital pain to visual disturbances and half had evident orbital involvement on imaging [31]. After surgical decompression via FESS, they reported "favorable outcomes, including symptom resolution" in essentially all patients, with no recurrences. In practical terms, a patient who presented with a visual acuity of counting fingers due to an optic nerve compressive mucocele might recover to 20/30 vision within weeks after surgery, as the nerve is decompressed and inflammation subsides (outcomes obviously vary by duration of compression). Another study focusing on AFRS-related proptosis showed that orbital proptosis significantly decreased after endoscopic sinus surgery when measured by exophthalmometry or orbital volume on imaging [7]. Stonebraker and Schlosser's earlier work [50] had quantitatively demonstrated orbital volume normalization after FESS in AFRS, and the 2020 case by Lee et al. echoes that qualitatively [7]. Even bony defects like a widened orbital wall can partially remodel after the chronic pressure is relieved, as bone slowly reforms.

Visual function often improves rapidly if the optic nerve was only compressed and not yet infarcted. For instance, in subperiosteal abscess cases, there are reports of patients regaining normal 20/20 vision from 20/400 pre-op once the abscess was drained and IV antibiotics administered, sometimes within 48–72 hours [3]. Diplopia can take a bit longer to resolve; if it was due to muscle restriction, patients may notice immediate improvement in motility after surgery, but full recovery might require days to weeks of reduced edema and perhaps some strabismus exercises. In some cases, temporary prism glasses are used during recovery if slight double vision lingers. Pain is typically the first symptom to improve postoperatively – patients often wake up from surgery with relief of the pressure pain that had been building.

On the other hand, failure to improve or any deterioration postoperatively is a serious concern. If vision worsens after sinus surgery, one must consider complications such as an intraoperative orbital hematoma or postoperative re-accumulation of pus. Fortunately, such events are uncommon (major orbital complications of FESS occur well under 1% in experienced hands [51] [52]. A review of FESS outcomes from 2020 found that orbital injuries (like muscle or optic nerve trauma) are rare and usually the result of surgical error or anomalous anatomy [53]. The use of stereotactic navigation and refined endoscopic instruments has helped minimize these risks. Nonetheless, it is important for the surgical team to remain vigilant for any orbital complication of the surgery itself – if a patient has increased pain or new vision loss after FESS, an urgent CT scan is indicated to rule out orbital hemorrhage compressing the nerve, which would require immediate canthotomy or surgical evacuation [54].

Overall, the prognosis for orbital complications of CRS is favorable when appropriately managed. A German review of sinogenic orbital complications [3] concluded that in 95–98% of cases categorized as mild to moderate (Chandler stages I–IV), complete healing without sequelae is achieved. Even in cases with preoperative visual impairment, the vision usually fully recovers with prompt therapy. Approximately 15% of those who undergo surgery may need more than one procedure (for example, a revision FESS if not all disease was cleared or if a new abscess forms), but

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ultimately anatomic and functional outcomes are good. The small minority of patients who end up with lasting issues (e.g. residual diplopia or vision loss) are typically those with either aggressive invasive disease or those who had significant delays in treatment [55,56].

The positive postoperative changes documented in recent literature reinforce the therapeutic role of FESS and allied measures. They also highlight a theme: multidisciplinary follow-up is as important as acute management. ENT surgeons ensure the sinuses remain clear (with debridements, treating any postoperative synechiae or stenosis), while ophthalmologists follow the patient's visual recovery and address any residual deficits (like prescribing prism for persistent small strabismus or recommending strabismus surgery in rare cases where muscle function does not fully recover). Rehabilitation services, such as vision therapy, can be helpful for patients who have experienced long-term diplopia. In cases of extensive orbital involvement, oculoplastic surgeons might be involved later for orbital reconstruction – for example, if an AFRS caused such deossification that orbital wall implants are needed for support, though typically FESS obviates that need by allowing bone to remodel as discussed in the case where changes were reversible [7].

Therapeutic Role of Functional Endoscopic Sinus Surgery (FESS)

Functional endoscopic sinus surgery has a dual role in the context of chronic rhinosinusitis with orbital complications: it is both curative for the sinus disease and therapeutic for the orbital pathology. The endoscopic approach aligns well with the goals of minimally invasive, yet effective treatment needed for these delicate situations. We have already touched on how FESS is used to drain abscesses and marsupialize mucoceles; here we will summarize and emphasize the overarching principles and specific techniques by which FESS addresses the ophthalmologic issues:

- **Decompression of Orbital Pressure:** One of the life- and sight-saving applications of FESS is relieving orbital compartment syndrome caused by sinus disease. By removing the lamina papyracea (or portions of it) endoscopically, the surgeon can release pus or allow an expanded orbital periosteum to fall back into place, immediately reducing pressure on the optic nerve and globe. In essence, an ethmoidectomy in this context acts like an orbital decompression. For example, in subperiosteal abscess drainage, the ENT surgeon carefully uncaps the thin bone and suctions out purulent material, which results in the once-proptotic eye often literally settling back as the pressure is relieved. This is analogous to how neurosurgeons perform craniotomies to relieve brain pressure – here the sinus surgeon performs an "orbitotomy" via the sinus. If the optic nerve is directly compressed by sphenoid pathology, FESS can be extended to an optic nerve decompression: opening the optic canal in the sphenoid sinus to relieve pressure on the optic nerve. This has been described for optic neuropathy due to sphenoid sinus mucoceles or fibrous dysplasia, and can be done on an urgent basis for optic nerve compression with some success in restoring vision [12] Such maneuvers should be done with image guidance due to the proximity of the carotid artery.
- **Drainage and Source Control:** FESS enables direct drainage of all sinonasal pus and removal of diseased tissue that fuels orbital infection. By performing a complete sphenoethmoidectomy and clearing the frontal recess, the surgeon ensures that no residual sequestrum or hidden abscess pocket remains to rekindle infection. This is particularly important in chronic suppurative sinusitis or chronic osteomyelitis that led to orbital cellulitis – simply draining the visible abscess may not suffice unless the sinus tracts are all opened. Modern endoscopes with angled lenses allow visualization into frontal sinus or far lateral maxillary sinus areas that were historically challenging. A 2024 study on risk factors for sphenoid sinusitis complications highlighted that patients with bony dehiscence on CT were more likely to develop orbital issues [18], underlining that thorough surgical correction of anatomical problems (like opening a obstructed sinus

ostium or removing a hyperostotic bone segment) is part of the solution. In essence, FESS addresses the root cause (obstruction and infection) thereby preventing further orbital sequelae after the acute issue is handled.

- **Targeted Orbital Procedures via FESS:** In addition to general sinus clearance, sometimes specific orbital surgical steps are taken endoscopically. For instance, if an orbital abscess has formed within the intraconal space (rare, but possible in chronic infection), an ENT surgeon can collaborate with an ophthalmologist to approach it. A medial orbital wall approach via the nose can reach some intraconal lesions; alternatively, a combined approach (endoscopic plus transcutaneous orbitotomy) may be arranged. Another scenario is dacryocystorhinostomy (DCR) – if chronic sinus inflammation scarred the nasolacrimal duct causing persistent tearing, an endoscopic DCR can be done to create a new tear drain into the nose. Although DCR is more oculoplastic than sinus surgery, many rhinologists perform endoscopic DCRs as part of comprehensive care for CRS patients with ocular complaints. This again highlights cross-disciplinary skills: the boundary between orbital and sinus surgery is increasingly collaborative.
- **Adjunctive Measures**: FESS is often accompanied by measures like placing sinus stents [57], using dissolvable spacers, or steroid-eluting implants in the sinuses to maintain patency and reduce inflammation after surgery. In orbital cases, the surgeon must balance aggressive clearance with preserving normal tissues, so sometimes a staged approach is used (address the emergency first, then do full polyp removal later, for example). In pediatric cases with orbital abscess, surgeons sometimes practice a limited drainage (just drain abscess and preserve more normal sinus mucosa) to reduce the impact on growing structures, but recent trends favor complete ethmoidectomy even in children to prevent recurrence [49]. Invasive fungal cases may require repeated endoscopic debridements over days or weeks, gradually clearing necrotic tissue as demarcated, rather than one-time surgery – a strategy often employed in mucormycosis management to improve outcomes [17].
- **Safety of FESS in Orbital Context:** One might ask, when the orbit is already compromised, how safe is it to operate so close to it? Experience has shown that FESS, when done carefully, is quite safe and in fact protective of the orbit. The use of powered instruments (like microdebriders) near the orbital wall necessitates caution – many surgeons will switch to fine instruments and curettes when removing bone adjacent to the periorbita. If orbital fat is exposed inadvertently, it is generally well tolerated (the fat will prolapse slightly but can be left alone to scar back in place) [52]. The presence of an abscess actually can make identification of planes easier in some cases – as soon as the lamina is opened, pus may gush out, clearly demarcating where the orbit is. Still, complications like extraocular muscle injury or optic nerve damage have been reported rarely in FESS, usually in complex anatomy or revision cases [58]. With proper training and modern tools [59], these risks are minimized. In fact, the risk/benefit calculation strongly favors FESS in orbital complication scenarios because the alternative (no surgery) risks permanent vision loss or brain infection. Notably, population-based studies have shown that the overall incidence of severe complications (orbital or brain injuries) after FESS is extremely low and has continued to decrease over the years [51] [60], thanks to better techniques and imaging.
- **Preventive Role:** Another aspect of FESS is preventing future orbital issues in patients with CRS. For instance, a child with chronic sinusitis and two episodes of orbital cellulitis might be offered FESS to clear the sinuses and stop the cycle of infection, thereby preventing a potentially worse complication on a subsequent episode. Similarly, a patient with a known frontal mucocele

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encroaching the orbit on imaging should get early endoscopic surgery to drain it, rather than waiting for it to cause vision problems. Guidelines in rhinology suggest that any evidence of orbital involvement or complications is an indication for surgical intervention in CRS. By extension, performing FESS in a timely manner for refractory CRS is a prophylactic measure against orbital and intracranial complications. The improved aeration and drainage of sinuses post-FESS make future sinus infections less likely to walled-off and spread. This preventive benefit is hard to quantify but is acknowledged in clinical practice. A study from 2021 found that after FESS for chronic sinusitis, the frequency of subsequent orbital cellulitis significantly dropped, indicating fewer sinus-related orbital infections in those patients [61]. Thus, FESS not only treats current problems but also helps avert recurrent or new orbital pathology down the line by resolving the chronic disease state.

In conclusion, functional endoscopic sinus surgery is an indispensable tool in the management of orbital consequences of CRS. Its minimally invasive nature, combined with maximal effectiveness in addressing pathology, makes it the treatment of choice in nearly all such cases. Whether it's draining an abscess, removing a mucocele, or debulking fungal disease, FESS addresses the cause and provides immediate relief to the orbit. The therapeutic successes documented across numerous studies in the 2020–2025 period, from Egypt to India to Europe [17,19] all reinforce that timely FESS (often in conjunction with medical therapy) leads to resolution of ophthalmologic morbidity in the vast majority of patients. As surgical technology advances and our understanding of sino-orbital diseases improves, FESS outcomes are likely to be even better, solidifying its central role in this interdisciplinary domain.

Multidisciplinary Care and Collaboration

Effective management of the ophthalmologic complications of chronic rhinosinusitis rests on strong multidisciplinary collaboration. These patients do not belong to one specialty alone; rather, they straddle the realms of otolaryngology, ophthalmology, radiology, infectious disease, and sometimes neurology or neurosurgery. A team-based approach not only expedites diagnosis and treatment but also improves safety and functional outcomes.

Early involvement of an ophthalmologist is crucial whenever an orbital complication is suspected in a sinusitis patient. The ophthalmologist's assessment of visual function, extraocular movements, and ocular health guides the urgency of intervention. For example, if an ENT physician notes some periorbital swelling in a CRS patient, a same-day ophthalmology consult might reveal an afferent pupillary defect or decreased acuity, immediately flagging a surgical emergency that might not have been obvious from external appearance. Ophthalmologists also provide essential perioperative support. In acute orbital compartment syndrome due to a sinus abscess or postoperative hemorrhage, an ophthalmologist may perform a lateral canthotomy to buy time and prevent optic nerve damage while sinus surgery is being arranged. In the postoperative period, they monitor the recovery of the optic nerve and muscles and can institute treatments like topical steroids for keratitis or prisms for diplopia as needed. Essentially, the ophthalmologist "co-manages" the patient's eye while the ENT surgeon manages the sinuses. This parallel care is highlighted by multiple reports urging interdisciplinary management for orbital cellulitis and abscess [49]. Trbojević et al. noted that in their pediatric orbital cellulitis cases, having pediatricians, ENT surgeons, and ophthalmologists jointly manage the case led to successful outcomes without long-term sequelae [49]. The same applies to adults, where coordination ensures that, for instance, the timing of surgery, choice of antibiotics, and need for adjuncts (like antifungals or steroids) are all considered from both ENT and eye perspectives.

The otorhinolaryngologist, for their part, should remain attuned to ocular signs and not hesitate to involve ophthalmology early. ENT doctors typically lead the surgical intervention and hospital care for these patients, but co-management with ophthalmology does not diminish that role – instead,

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it augments patient monitoring. In complex cases, some centers have even developed joint ENT-ophthalmology orbital centers or rounds. In Germany, for example, interdisciplinary "orbita centers" have ENT and ophthalmology specialists together evaluate sino-orbital diseases [3]. This kind of integrated care model ensures nothing is missed.

Radiologists play a pivotal role by quickly reading imaging and sometimes consulting on the findings with the surgical team. In many hospitals, when an orbital complication is suspected, the CT scan is marked urgent and a radiologist may personally alert the clinical team if a drainable abscess or thrombosis is seen. Additionally, advanced radiologic techniques like diffusion-weighted MRI can differentiate orbital cellulitis from abscess [62], helping decide if surgery is needed. Interventional radiologists might rarely be involved if transcutaneous drainage were considered (not common for orbit), but mostly it's diagnostic radiology that's key. Having radiologists experienced in sinonasal anatomy helps to identify subtle dehiscences or atypical path (like an Onodi cell mucocele compressing the optic nerve).

In cases of intracranial extension (e.g. meningitis, brain abscess, cavernous sinus thrombosis from sinusitis), neurosurgery and neurology join the team. Neurosurgeons [63] may be needed to drain a frontal lobe abscess or to perform craniotomy if infection has spread beyond what endoscopy can handle. They may also assist in orbital apex decompression if the disease has gone through the orbital apex into the cavernous sinus region. Neurologists often help manage cavernous sinus thrombosis with anticoagulation protocols and monitor neurological status. These scenarios are fortunately rare in chronic sinusitis (more common in acute fulminant infections), but they do occur particularly in invasive fungal cases. A multi-specialty emergency like cavernous sinus thrombosis might have ENT doing sphenoid sinus drainage, ophthalmology managing the eye and administering broad antibiotics, neurology overseeing anticoagulation [64] and ICU care, and neurosurgery on standby for any needed cranial intervention. Each has a role to play.

For immunocompromised patients or atypical infections, infectious disease specialists are invaluable. They help choose appropriate antimicrobial therapy (antibiotics, antifungals) and adjust it based on cultures. In the COVID-associated mucormycosis epidemic, for example, infectious disease teams in India helped formulate guidelines for amphotericin B dosing and adjunctive therapies which ENT and ophthalmology teams implemented surgically [17] In chronic bacterial osteomyelitis of the sinus/orbit, long-term antibiotics may be required, and an infectious disease physician can monitor levels and side effects. Furthermore, if the patient has underlying conditions like HIV or diabetes, the medical team and endocrinologists are engaged to optimize overall health – for instance, controlling blood sugar aggressively in a diabetic with invasive fungal sinusitis is lifesaving.

Lastly, the patient's primary care provider or pediatrician is often looped in to ensure continuity of care after the acute phase. Children who have had an orbital complication of CRS might need allergy evaluations (since allergic rhinitis can underlie sinusitis) or immune workups if they had unusually severe infections. Adults might need smoking cessation support or treatment of comorbid chronic conditions to prevent sinus disease recurrence.

Clear communication among all team members is the bedrock of success. This includes discussing the timing of surgery (e.g. don't delay if ophthalmology exam shows deterioration – escalate surgery timing), agreeing on monitoring protocols (how often to check vision, perform imaging, etc.), and contingency planning (if X happens, what do we do). Many centers develop clinical pathways or checklists for orbital cellulitis that involve both ENT and ophthalmology checkpoints [49]. Such standardized protocols can improve outcomes by ensuring, for example, that any child with orbital cellulitis gets an ophthalmology exam within an hour of admission and a CT scan within two hours, and if an abscess > a certain size is found, ENT takes the child to surgery within the next few hours – a coordinated timeline that requires all hands on deck.

In summary, multidisciplinary care is not just a buzzword but a literal lifesaver in orbital complications of CRS. The orbit is a small space shared by many systems (sinus, eye, brain circulation). ENT surgeons and ophthalmologists working in tandem – often along with radiologists,

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pediatricians, neurosurgeons, and others – exemplify the collaborative spirit needed to tackle these complex cases The literature consistently concludes that interdisciplinary management leads to the best outcomes either in severe CRS [65] or specificially to orbital complications of CRS [19]. Patients benefit from the pooled expertise, and the risk of overlooking critical detail is greatly reduced. As healthcare moves toward integrated specialty teams for complex diseases, sino-orbital pathology stands out as an area that has long embraced this approach. This collaborative care should continue through follow-up, rehabilitation, and any secondary interventions required, ensuring the patient's sinus disease and visual function are both optimized.

It is also worth noting that ongoing research and emerging technologies continue to refine our approach. For example, advances in endoscopic instrumentation and intraoperative imaging might allow even safer and more complete removal of disease near critical orbital structures. The rise of multidisciplinary simulation training for orbital complication management (drilling scenarios for canthotomy and FESS in hemorrhage situations) is improving team preparedness. From a preventive angle, better medical management of CRS – biologic therapies for polyps, improved allergy control, etc. – may reduce the incidence of such complications in the first place. The COVID-19 pandemic's surge of rhino-orbital mucormycosis taught clinicians valuable lessons in early recognition of orbital fungal infection and aggressive combined treatment, knowledge that will inform future care of immunosuppressed patients.

Conclusion

Chronic rhinosinusitis, though primarily a sinonasal disease, has important and potentially severe orbital consequences. The thin partitions and shared vascular connections between the sinuses and the orbit mean that protracted sinus inflammation can spill over to involve the eye.

In this contemporary review, we have drawn upon at least 90 peer-reviewed sources from 2020–2025 to ensure the information is up-to-date and reflective of current best practices. The convergence of ENT and ophthalmology in managing CRS complications has never been stronger, and patients are the beneficiaries of this synergy. Going forward, continued collaborative research (e.g. joint case series, clinical trials for treatments in orbital complications) will further improve our understanding and outcomes.

Another recurring theme is the necessity of a multidisciplinary approach. Optimal care arises from the collaboration of otolaryngologists, ophthalmologists, radiologists, and other specialists who together navigate these challenging cases. The literature from 2020–2025 strongly advocates for such interdisciplinary management, citing improved patient outcomes and safety. As a result, many centers managing CRS complications have formal or informal combined teams for sino-orbital diseases, a practice that should be encouraged universally.

In conclusion, the ophthalmologic impact of chronic rhinosinusitis is significant but largely manageable. Intraorbital pressure elevations, diplopia, proptosis, and vision loss caused by CRS demand urgent attention, but with modern endoscopic surgery and multidisciplinary care, patients often experience complete recovery of ocular function. Functional endoscopic sinus surgery has proven to be a safe and highly effective therapeutic modality, both resolving active complications and preventing future ones. Fortunately, FESS not only resolves the acute issue but restores normal sinus function to help prevent recurrence of the orbital problem. Clinicians should remain vigilant for orbital symptoms in CRS, work closely across specialties, and intervene promptly to protect the vital sense of sight. The successful outcomes reported in recent literature offer both guidance and hope: even in complex sino-orbital disease, appropriate therapy can lead to healing "without further sequelae" in the great majority of cases.

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