SILENT SINUS SYNDROME: A SILENT FACIAL DEFORMITY

Silent sinus syndrome: Tichá deformácia tváre

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Abstract
Silent sinus syndrome (SSS) is a rare clinical entity characterized by spontaneous enophthalmos and hypoglobus resulting from progressive implosion of the maxillary sinus walls, typically caused by chronic, asymptomatic obstruction of the osteomeatal complex (OMC). Patients usually present with subtle facial asymmetry, which may be the only initial symptom. This paper summarizes the clinical presentation, diagnostic criteria, and treatment options for SSS and reports the case of a 33-year-old woman diagnosed with unilateral SSS based on computed tomography (CT) findings. Imaging demonstrated the hallmark features of the disease, including maxillary sinus volume loss, orbital floor depression, and anatomical variations predisposing to OMC obstruction. The gold standard treatment is endoscopic supraturbinal antrostomy as part of functional endoscopic sinus surgery (FESS), aimed at restoring sinus ventilation. Orbital floor reconstruction is reserved for cases with insufficient post-antrostomy remodeling. In the present case, antrostomy alone achieved complete functional and aesthetic resolution. Early diagnosis is essential to prevent permanent orbital deformity, and management frequently requires a multidisciplinary team including ophthalmologists, otolaryngologists, and maxillofacial (head and neck) surgeons *(Tab. 1, Fig. 3, Ref. 15). Text in PDF www.lekarsky.herba.sk.*
KEY WORDS: silent sinus syndrome, enophthalmos, maxillary atelectasis, antrostomy, orbital reconstruction.

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Abstrakt
Syndróm tichého sínusu (SSS) je zriedkavé ochorenie, ktoré sa prejavuje spontánnym enoftalmom a hypoglobom spôsobenými postupným kolapsom stien čeľustnej dutiny. Tento proces zvyčajne vzniká v dôsledku chronickej, bezpríznakovej obštrukcie osteomeatálneho komplexu (OMC). Najčastejším a často jediným počiatočným príznakom býva nenápadná asymetria tváre.
Článok sa zameriava na klinické prejavy, diagnostické kritériá a možnosti liečby SSS a opisuje prípad 33-ročnej ženy s jednostranným SSS diagnostikovaným na základe CT vyšetrenia. Zobrazovacie metódy ukázali typické zmeny pre toto ochorenie, vrátane straty objemu čeľustnej dutiny, prepadnutia spodiny očnice a anatomických variácií, ktoré predisponujú k obštrukcii OMC.
V súčasnosti je zlatým štandardom liečby endoskopická supraturbinálna antrostómia vykonávaná ako súčasť funkčnej endoskopickej chirurgie prínosových dutín (FESS), ktorej cieľom je obnovenie normálnej ventilácie dutiny. Rekonštrukcia spodiny očnice sa zvažuje iba v prípadoch, keď remodelácia po antrostómii nie je dostatočná. V tomto prípade samotná antrostómia viedla k úplnému funkčnému aj estetickému zotaveniu.
Včasné rozpoznanie SSS je kľúčové na predchádzanie trvalým orbitálnym deformitám. Úspešná liečba často vyžaduje multidisciplinárny tím, do ktorého patria oftalmológovia, otorinolaryngológovia a maxilofaciálni chirurgovia *(tab. 1, obr. 3, lit. 15). Text v PDF www.lekarsky.herba.sk.*
KĽÚČOVÉ SLOVÁ: syndróm tichého sínu, enoftalmus, atelektáza čeľustnej dutiny, antrostómia, rekonštrukcia očnice.
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Introduction

Silent sinus syndrome (SSS), also known as *silent antrum syndrome* or *imploding antrum syndrome*, is a rare clinical phenomenon characterized by spontaneous enophthalmos and hypoglobus resulting from progressive collapse of the orbital floor. This condition arises from chronic, asymptomatic maxillary sinus atelectasis secondary to obstruction of the osteomeatal complex (OMC). Since patients typically do not exhibit classic signs of sinusitis – such as nasal discharge or facial pain – the condition is termed ‚silent sinus syndrome' (1).

In the literature, SSS is often associated with chronic maxillary atelectasis (CMA), a condition characterized by a gradual loss of maxillary sinus volume due to inward retraction of the bony walls. The terms SSS and CMA are sometimes used interchangeably, but they likely represent different points along the same pathological spectrum. In this context, SSS corresponds to Stage III of CMA – the most advanced phase involving visible facial and orbital deformities (Tab. 1) (1, 2, 3).

In this article, we describe the case of a 33-year-old woman who presented with a progressive change in facial appearance over several months, characterized by orbital asymmetry and ptosis of the upper eyelid on one side. Clinical photographs, imaging studies, and intraoperative footage are provided to illustrate the typical presentation of SSS, along with pre- and postoperative findings.

Table 1. Classification of chronic maxillary atelectasis (CMA)**.** Silent sinus syndrome represents the most severe, third stage of CMA (Adapted from Brandt & Wright, 2009).

Stage	Type of Deformity	Characteristic Features
I	Membranous deformity	Posterior maxillary fontanelle displaced laterally
II	Bony deformity	Inward bowing of one or more bony walls of the maxillary sinus (anterior, superior, and/or posterolateral wall)
III	Clinical deformity	Presence of enophthalmos, hypoglobus, and/or midfacial deformity

Epidemiology

SSS is considered a rare clinical entity. It is typically diagnosed in adults between 30 and 50 years of age (4, 5) and is equally distributed between males and females (1, 3). Patients are more often referred for evaluation by ophthalmologists due to progressive enophthalmos, hypoglobus, or diplopia, rather than by otolaryngologists for sinonasal complaints. As a result, diagnosis may be delayed, and the true prevalence of the condition is likely underestimated (2).

Etiology

This syndrome is a consequence of chronic hypoventilation of the maxillary sinus, occurring secondary to obstruction of the osteomeatal complex (5, 6). Such obstruction impairs the normal aeration and mucociliary clearance of the sinus, leading to progressive resorption of intra-sinus gas. As the trapped air is absorbed, a persistent negative pressure develops within the sinus cavity (7). This negative pressure, in combination with chronic inflammation, promotes mucosal remodeling and osteopenia of the sinus walls. The weakened bony architecture gradually collapses inward, particularly affecting the thin orbital floor, resulting in enophthalmos, hypoglobus, and occasionally diplopia.

Various factors may contribute to the obstruction of the natural maxillary ostium, including:

- Anatomical variations (e.g., lateralized middle turbinate, infraorbital location of ethmoidal cells).
- Chronic mucosal inflammatory changes (e.g., nasal polyps, mucoceles, sinusitis).
- Iatrogenic factors (e.g., trauma during intubation, prolonged placement of nasal tubes) (6, 8).

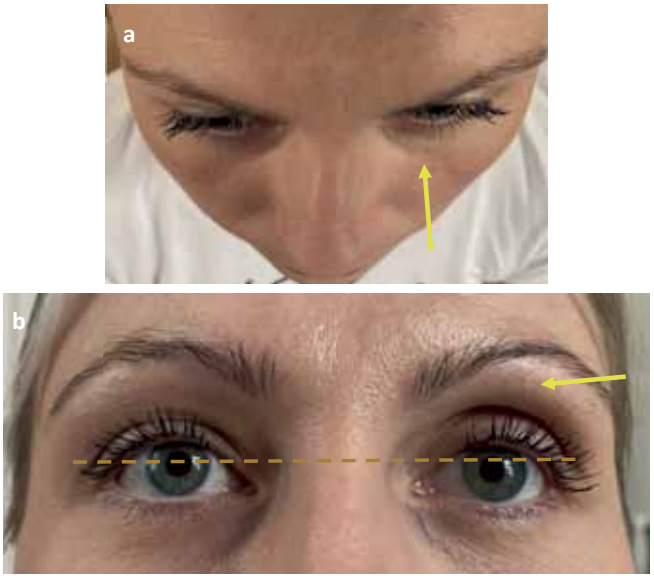
Clinical symptoms

SSS is typically a slowly progressive condition, with symptoms developing over several weeks to months or even years (5). The disease is almost exclusively unilateral (9). Patients most commonly report a change in facial appearance, with enophthalmos representing the dominant clinical manifestation (3, 5).

The typical clinical signs of SSS include:

- **Enophthalmos** (posterior displacement of the eyeball within the orbit) is present in 98–100% of cases, typically ranging from 2 to 6 mm (3).
- **Hypoglobus** (inferior displacement of the eyeball within the orbit) occurs in approximately 50% of patients, with a displacement of 1 to 6 mm (3).
- **Changes in eyelid position**, including pseudoretraction (pseudo-Graefe sign) or pseudoptosis, are present in approximately 88% of cases. Inferior displacement of the eyeball may cause tension on the eyelid, resulting in its apparent elevation (retraction) or, conversely, its apparent drooping (ptosis) (3, 5).
- **Diplopia** may occur secondarily due to dysfunction of the superior and inferior oblique extraocular muscles. Since these muscles originate from the bony orbit, their function can be affected by altered globe position (5).
- **Absence of sinusitis symptoms –** patients generally do not exhibit the typical signs of acute or chronic paranasal sinus inflammation (Fig. 1) (1, 5).

Figure 1. Enophthalmos, hypoglobus and eyelid position changes. The female patient with SSS presenting with left-sided enophthalmos (a, arrow), mild hypoglobus marked with a dashed line and pseudoretraction of the left upper eyelid (b, arrow).



Diagnosis

The diagnostic criteria for SSS include:

1. Spontaneous enophthalmos and/or hypoglobus.
2. Absence of sinusitis symptoms (e.g., pain, discharge, nasal congestion).
3. CT evidence of a collapsed maxillary sinus.
4. Exclusion of traumatic or other known etiologies (1, 5, 10).

Computed tomography (CT) remains the gold standard for diagnosing SSS. It typically demonstrates maxillary sinus opacification, inward bowing of the sinus walls, reduced sinus volume, and inferior depression of the orbital floor. Additional findings may include septal deviation toward the affected side or abnormal positioning of the middle turbinate (Fig. 2) (3).

In most cases, CT imaging is sufficient for establishing the diagnosis. Magnetic resonance imaging (MRI) is

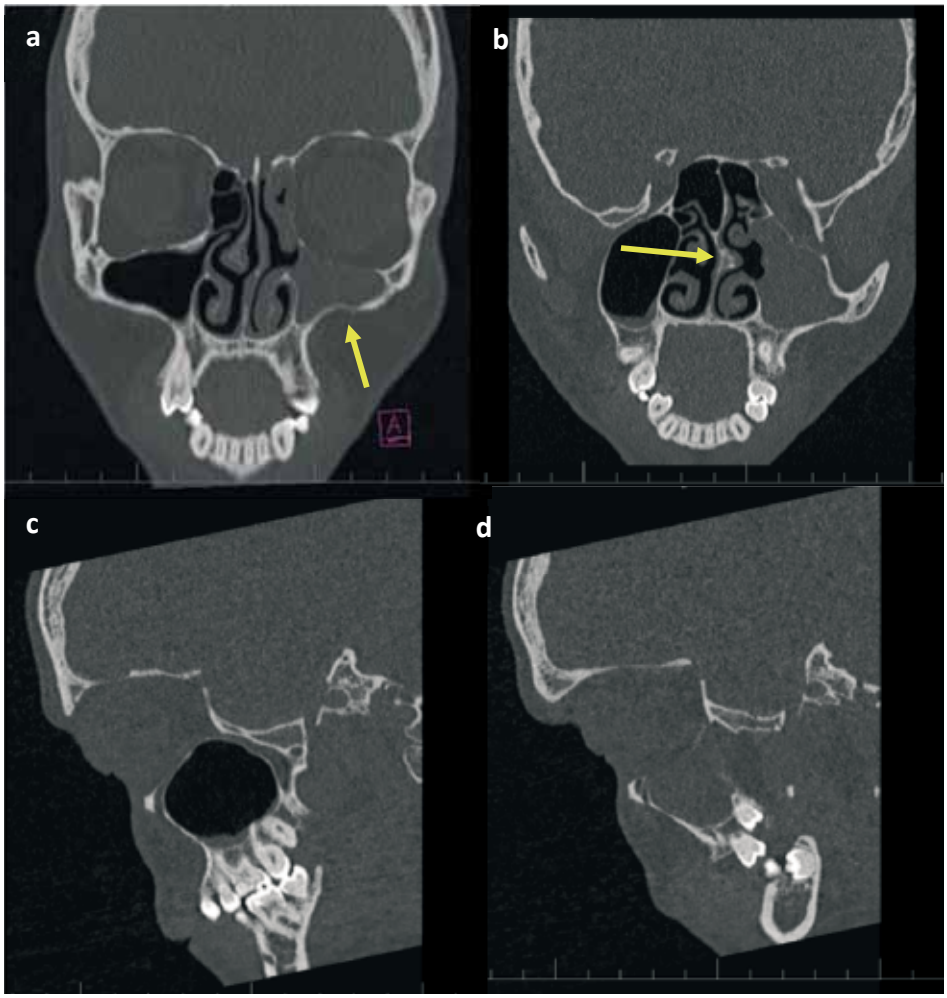


Figure 2. CT sections of the patient demonstrating features of SSS. Typical left-sided findings including orbital asymmetry, reduced maxillary sinus volume, hyperdense content within the sinus, and orbital floor depression (a, arrow). Besides the typical findings of SSS, septal deviation with a vomer spine extending into the middle nasal meatus was also present (b, arrow). Normal findings in the right orbit and maxillary sinus, shown for comparison (c). Left maxillary sinus is filled with hyperdense content, with an altered S-shaped configuration of the orbital floor with inferior depression (d).

reserved for selected situations, particularly when a more detailed assessment of orbital fat, extraocular muscles, or the optic nerve is required (11).

Differential diagnosis

When establishing the diagnosis, other causes of enophthalmos and orbital changes should be considered to avoid misdiagnosis. These include unrecognized orbital fractures leading to globe displacement; congenital facial asymmetry; and contralateral exophthalmos (e.g. in Graves' orbitopathy), which may mimic enophthalmos on the opposite side. Parry-Romberg syndrome, characterized by progressive hemifacial atrophy, and chronic osteomyelitis of facial bones, which may remodel the maxilla or orbit, should also be taken into account (5, 10).

Treatment

The management of SSS is primarily surgical, aiming to restore normal maxillary sinus ventilation and, when required, to reconstruct the affected orbital walls. Nonsurgical approaches may be considered only as a temporary option in mild cases of enophthalmos.

Surgical Treatment

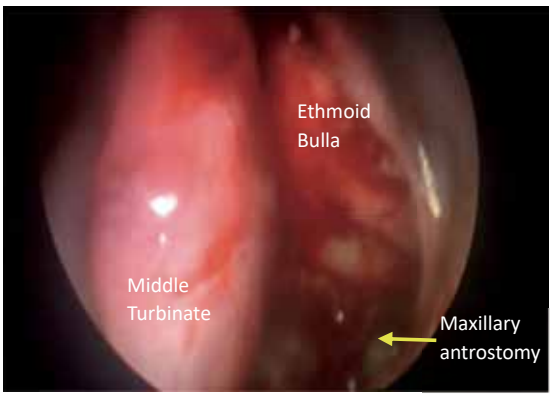
Antrostomy

Endoscopic supraturbinal antrostomy is regarded as the gold standard for relieving obstruction of the osteomeatal complex and re-establishing maxillary sinus ventilation. It is usually performed as part of functional endoscopic sinus surgery (FESS) and consists of creating an opening into the maxillary sinus above the inferior turbinate. The procedure often includes correction of anatomical variations, such as a deviated nasal septum, hypertrophy, or lateralization of the middle turbinate, and other abnormalities contributing to chronic obstruction (Fig. 3) (12).

Because of the altered orbital anatomy, the surgery must be carried out with caution to avoid perforation of the lamina papyracea, which can result in complications such as retrobulbar hematoma, diplopia, subcutaneous emphysema, orbital infection (cellulitis, abscess), or, in severe cases, pneumocephalus and intracranial complications (12).

In a considerable proportion of patients, restoring sinus ventilation alone leads to gradual, spontaneous remodeling of the orbital floor. As normal aeration is re-established, intra-sinus pressure normalizes and the orbital contents may return to their physiological position without the need for orbital reconstruction. Reported outcomes indicate that 80–95% of patients experience partial or complete resolution of symptoms such as enophthalmos, hypoglobus and diplopia following supraturbinal antrostomy alone (1, 6, 11).

Figure 3. Endoscopic supraturbinal antrostomy. The patient underwent functional endoscopic sinus surgery (FESS) with a supraturbinal antrostomy at the ENT Clinic. During the procedure, hyperostosis extending into the middle nasal meatus was also removed. Intraoperative view (source: Department of Otorhinolaryngology and Head and Neck Surgery, St. Michael's Hospital).



These observations support a therapeutic strategy in which orbital floor reconstruction is postponed and considered only in cases where clinical improvement remains insufficient after several months of follow-up. This interval allows for comprehensive assessment of both anatomical and functional changes through clinical evaluation and imaging (11, 13). In our patient, symptoms resolved completely after supraturbinal antrostomy, and no additional treatment was necessary.

Orbital floor reconstruction

The role of performing orbital floor reconstruction simultaneously with antrostomy remains a matter of debate. After restoring maxillary sinus ventilation and alleviating negative pressure, spontaneous remodeling of the orbital floor may occur; however, the degree of orbital volume correction is highly variable and difficult to predict (1, 5).

Secondary correction of enophthalmos is usually indicated in patients with significant facial deformity or persistent orbital symptoms (11). It is generally recommended to wait at least six months after antrostomy to evaluate spontaneous sinus remodeling (1). Simultaneous antrostomy and orbital reconstruction may be considered in patients with severe enophthalmos (13).

Modern reconstruction techniques employ 3D planning with "mirroring" of the healthy contralateral orbit. CT data of the intact orbital floor are mirrored to the affected side, restoring the original S-shaped orbital floor architecture. The resulting model is used to design a patient-specific implant (PSI), typically 3D-printed in titanium. These implants provide high anatomical precision, facilitate optimal orbital volume restoration and reduce postoperative complications such as enophthalmos and diplopia (1, 5, 13).

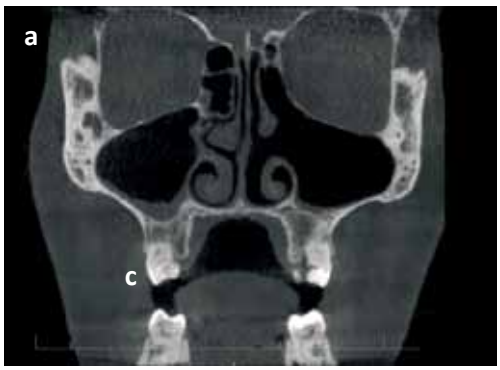
Non-surgical Treatment

In patients with mild enophthalmos or contraindications to surgery, temporary correction with injectable hyaluronic acid fillers into the intra- and extraconal orbital spaces may be considered (14).

Discussion

Enophthalmos secondary to maxillary sinus pathology was first described by Montgomery in 1964 (15),

Figure 4. Postoperative findings one year after left-sided supraturbinal antrostomy. (a, coronal CT) Re-aeration and volume re-expansion of the left maxillary sinus, with marked improvement in orbital asymmetry. (b, sagittal CT) Gradual restoration of the physiological S-shaped configuration of the left orbital floor . (c) Clinical evaluation demonstrated normalization of globe position and resolution of the upper eyelid deformity – pseudoretraction.



and the term *silent sinus syndrome* was introduced by Soparkar et al. in 1994 to emphasize the absence of sinonasal symptoms despite characteristic orbital deformities (5). SSS is now widely regarded as the end stage of chronic maxillary atelectasis (CMA), characterized by progressive inward bowing of the sinus walls, due to negative pressure from chronic obstruction of the osteomeatal complex (1). Radiological findings are typically diagnostic. Rose et al. described the characteristic "imploding antrum" appearance on CT, including maxillary sinus volume loss, medialization of the lateral sinus wall, and orbital floor depression (3).

The management of SSS continues to be debated, particularly regarding the timing of orbital floor reconstruction. While some authors favor a single-stage approach combining FESS with immediate orbital repair, most recommend a staged strategy, reserving orbital reconstruction for patients with persistent functional or cosmetic deficits (1, 4). Several studies support this approach, as re-establishing sinus ventilation alone often leads to partial or complete resolution of enophthalmos, hypoglobus, and diplopia (11, 13).

Our case supports this strategy: supraturbinal antrostomy achieved sinus re-aeration, orbital floor remodeling, with complete symptom resolution. No further surgical intervention was required. This outcome highlights the potential for spontaneous recovery of orbital anatomy and function once normal sinus physiology is restored.

Conclusion

Silent sinus syndrome (SSS) should be considered in the differential diagnosis of progressive enophthalmos or hypoglobus in the absence of sinonasal symptoms. Because of its predominantly ophthalmologic presentation, the condition is often first recognized by ophthalmologists, whereas definitive management with endoscopic supraturbinal antrostomy is typically performed by otolaryngologists. Orbital reconstruction may be required in selected cases to address persistent cosmetic or functional defects, frequently in collaboration with maxillofacial (head and neck) surgeons. Early recognition and timely multidisciplinary management are crucial to prevent progression of orbital deformity and to ensure optimal functional and aesthetic outcomes.*

*__Compliance with Ethics Requirements:__ Authors declare no conflict of interest regarding this article. The authors declare, that all the procedures and experiments of this research respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008 (5), as well as the national law.

__Conflict of interest:__ The authors declare no conflict of interest.

__Informed consent:__ Informed consent was obtained from all individual participans included in the study.

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