



## Bilateral Maxillary Sinus Hypoplasia: Case Report and Differential Diagnostic Criteria

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### Abstract

**Introduction:** Maxillary Sinus Hypoplasia (MSH) is rare developmental anomaly, especially its bilateral form. Many patients are asymptomatic, while others have developed symptoms: Headaches, nasal congestion, phonation disorder or facial pain, all suggestive of sinusitis. Inflammation by itself affects hypo-plastic sinuses in cases where ostium complex is compromised, making cause-and-effect diagnostic doubts.

**Case Report:** We present a rare case of bilateral maxillary sinus hypoplasia in a 69-year-old, symptomatic patient. Patient didn't respond to anti-inflammatory therapy, and no radiological signs of sinus inflammation were evident.

**Conclusion:** According to exclusion criteria we made a diagnosis of symptomatic, but pure, and non-complicated bilateral MSH. Recognition of MSH, as well as its evaluation and grading, are of indisputable importance in terms of resolving differential diagnostic doubts and planning surgical interventions in the maxillofacial region.

**Keywords:** Maxillary sinus; Hypoplasia; Differential diagnosis; Diagnostic criteria

### Introduction

Among the paranasal cavities, hypoplasia most often affects the frontal and sphenoid sinuses [1]. Maxillary Sinus Hypoplasia (MSH) is a relatively rare developmental anomaly, especially the bilateral form [2]. Hypoplastic sinus can be of unknown cause, occurring as part of a congenital syndrome, but also external factors such as trauma, infection or irradiation can lead to developmental delays and reduced sinus pneumatization. Hypoplasia should be distinguished from sinus hypotrophy, which occurs secondarily and affects previously normally pneumatized sinuses, consequently to trauma, chronic infection or surgery [3]. Many patients are asymptomatic, while others have developed symptoms: Headaches, nasal congestion, phonation disorder or facial pain. These symptoms often indicate the clinical diagnosis of sinusitis, according to which the therapy is prescribed. Sinusitis may be associated with MSH in cases with compromised ostial drainage, but may also develop in appropriately pneumatized sinuses.

We present a rare case of bilateral, symmetrical maxillary sinus hypoplasia, accompanied by symptoms of nasal obstruction and frequent headaches, but without radiological signs of an inflammatory disorder.

### Case Presentation

A 69-year-old patient came to our Diagnostic Center with a referral diagnosis of headache and chronic, long-term nasal obstruction, and without laboratory signs of inflammation. She was treated initially with antibiotic therapy, and then with antiallergic drugs, nasal decongestants and nasal corticosteroid sprays. There has been no history of previous trauma or surgery at the level of the sinonasal complex, as well as associated systemic diseases and possible developmental syndrome. The patient suffered from arterial hypertension and was taking antihypertensive therapy.

Indicated CT examination showed bilateral maxillary hypoplasia (Figure 1, 2), with preserved patency of the maxillary sinus ostia. The volume of the sinuses was calculated according to formula given by Sahlstrand-Johnson et al. [4]:

$$(ML \text{ dimension} \times SI \text{ dimension} \times AP \text{ dimension})/2,$$

where: ML dimension is the biggest mediolateral dimension; SI dimension is the biggest superoinferior dimension; AP dimension is the biggest anteroposterior dimension (Figure 1).

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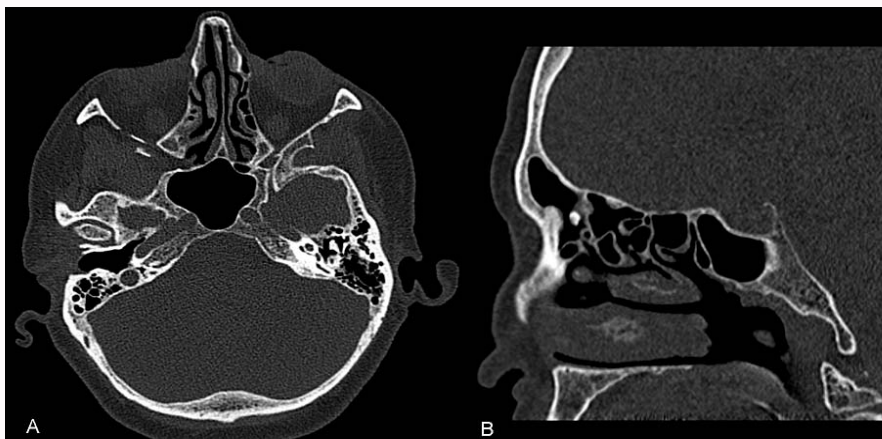
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**Figure 1: A. Transverse cross section:** Note the hypoplastic maxillary sinuses and deviated nasal septum. **B. Coronal reformation:** Note the preserved patency of sinus ostia and the insignificant (<2 mm) mucosal thickening.



**Figure 2: A. 3D volume rendering- bones:** Note the elevated canine fossa, and the absence of maxillary bone hypoplasia; **B. 3D volume rendering- airways:** Note hypoplastic maxillary sinuses.



**Figure 3: A. Transverse cross section:** Note the hypoplasia of the left sphenoid sinus. **B. Sagittal reformation:** Note a small osteoma in the infundibulum of the frontal sinus.

The estimated maxillary sinus volumes in presented case were 4.73 cm<sup>3</sup> on the right, and 3.48 cm<sup>3</sup> on the left side.

There was minimal mucosal thickening (up to 2 mm) in some parts of both sinuses, insignificant from both radiological and clinical aspects. Bony walls of both sinuses were intact, and with no detected inward bowing. Also, noted was the bilateral lateral extension of the nasal cavity at the level of the lower nasal passages, and developed,

though moderately smaller, both uncinat processes (Figure 1). Other findings were hypoplasia of the left sphenoid sinus, minor osteoma in the infundibulum of the left frontal sinus and deviation of the nasal septum (Figure 1, 3).

## Discussion

MSH is a rare developmental anomaly. The overall prevalence of MSH is in the range of 1.5% to 10%, although some studies reported

even lower values [5,6]. The prevalence of bilateral MSH is far lower and estimated at 0.4% to 0.6% [6]. According to our experience, out of 1651 examinations of the sinus region, in the period from January 2018 to the end of December 2021, 24 patients were diagnosed with MSH (1.4%), with only one case having a symmetrical-bilateral form (0.06%).

Based on clinical signs and only conventional radiography findings, MSH is often misdiagnosed as sinusitis, exceptionally as a neoplasm, and in that sense, can represent a diagnostic problem. Making an appropriate diagnosis is further complicated by the fact that MSH can be an isolated entity, but also combined or have a cause-and-effect relationship with sinusitis. It is considered that inflammation in the first years of life can impair normal sinus development [6], and *vice versa*, MSH associated with compromised ostial drainage may result in sinusitis. In the presented case, the patient was treated continuously for 5 to 6 months under the diagnosis of recurrent rhino-sinusitis, but without effect. The indicated CT examination showed that she was dealing only with MSH, without elements of inflammation, and/or ostial obstruction. On the other hand, conditions such as Silent Sinus Syndrome (SSS) or acquired post-traumatic small sinus can be misdiagnosed as sinus hypoplasia or aplasia [3]. SSS is characterized with the absence of sinonasal symptoms, and corresponds to a chronic, progressive maxillary sinus atelectasis with inward bowing of the maxillary sinus walls, resulting in enophthalmos, hypoglobus, and/or facial deformity [7]. Possible causes of this disorder are the chronic maxillary hypoventilation, along with ostial obstruction. None of the above was observed in our case, suggesting pure, symmetrical MSH, without associated sinus inflammation or hypoplasia of the maxillary bone.

The diagnostic criteria for MSH are not fully harmonized and differ among studies. In a study by Alsufyani et al. [5], MSH was defined as the failure of pneumatization to the level of the nasal cavity floor and zygomatic bone. Other studies consider associated findings on surrounding facial structures (i.e., increase in vertical orbital dimension, elevated canine fossa, enlarged superior orbital and pterygopalatine fossa, and lateral position of infra-orbital foramen), as indicative for MSH [6]. A study conducted by Dedeoğlu and Duman 2020, relies on a comparative analysis of the sinus dimensions to the same-sided orbit: Each maxillary sinus with half or less of the maximum horizontal or vertical linear dimension of the orbit was defined as hypoplastic [8]. In the presented case, both sinuses met each of the above criteria. When diagnosing MSH, the age of the patient should also be taken into account. Namely, the maxillary sinus at birth has a volume of about 6 mm<sup>3</sup> to 8 mm<sup>3</sup>, and reaches its final pneumatization after the eruption of the maxillary posterior teeth, at the age of 15 to 18 years [8,9]. We presented a patient with completed development of the maxillary sinuses in the age of 69 years.

Grading of MSH is also important. Bolger et al. [10] described three grades of MSH, relying on infundibular passage and uncinata process development, besides roughly determined sinus size. Infundibular passage is significant in terms of propensity to develop sinus inflammation, while uncinata process hypoplasia can increase the risk of complications during the Functional Endoscopic Sinus Surgery (FESS). To our knowledge, there are no established objective criteria for the differentiation of mild, moderate and profound sinus hypoplasia, as given in Bolger's grading system. Volumetric studies or determination of certain metric parameters of the sinus cavity in relation to the surrounding anatomical structures could give a

more objective categorization of the degree of MSH. According to Bolger's criteria, the presented case would correspond to type I, as the patient had bilaterally developed uncinata process, and preserved infundibular passage. The estimated maxillary sinus volumes in presented case were approximately 4 cm<sup>3</sup>, while the average adult values, given in the literature, are: 17.21 ± 6.26 in men, and 11.58 ± 4.90 cm<sup>3</sup> in women [11].

The significance of the MSH lie in its influence on the course of some pathological conditions, but also on the choice of approach, in terms of avoiding possible complications, when planning surgical procedures in this region. Matsuhita et al. [12] described thickening of the nasal mucosa as a consequence of apical periodontitis in the case of MSH, which occurs due to lateral extension of the nasal cavity - above the tooth root. MSH can also affect altered transmission of forces and distribution of stress during trauma. Given the well-known fact that normally developed anatomical structures usually act as shock absorbers and affect the avoidance of life-threatening injuries, MSH could disrupt this defense mechanism [12]. Recognition of MSH and its grading according to Bolger's classification can prevent complications such as injury to orbital structures, occurring during the FESS and uncinatotomy. MSH also causes the lateral extension of the nasal wall, and thus may contribute to the technical difficulty of the FESS [7]. However, it has to be pointed that MSH can also influence the approach and course of other surgical procedures in this region. With MSH, the direction and extent of fragment movement may be limited in Le Fort I osteotomy, undertaken to treat patients with jaw deformity [1]. Finally, from the oral-surgical aspect, placing the implant in the posterior region of the upper jaw may require elevation of the sinus floor, which can lead to perforation or damage to the Schneiderian membrane [8]. This procedure also requires prior detailed acquaintance with the morphology and size of the maxillary sinus [9,10].

Recognition of MSH, its precise definition and grading are of indisputable importance in terms of resolving differential diagnostic doubts and planning surgical interventions. Having in mind the possibilities of modern diagnostic methods, and on the other hand - a continuous development of newer operative techniques in the maxillofacial region, the revision of the classification and grading of this entity is quite certain and expected.

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