e-ISSN: 2747-2051

Archives of the Medicine and Case Reports

[AMCR]

https://hmpublisher.com/index.php/amcr

Non-Keratinizing Sinonasal Squamous Cell Carcinoma Extending to the Skull Base: Surgical Management with Total Maxillectomy - A Case Study

Anak Agung Wira Ryantama[1*], Eka Putra Setiawan[1], Wayan Lolik Lesmana[1], Agus Rudi Asthuta[1], Komang Andi Dwi Saputra[1], Luh Sartika Sari[1]

[1]Department of Otorhinolaryngology and Head/Neck Surgery, Faculty of Medicine, Universitas Udayana/Prof. Dr. I.G.N.G. Ngoerah General Hospital, Denpasar, Indonesia

ARTICLE INFO

Keywords:
Maxillectomy
Non-keratinizing
Sinonasal squamous cell carcinoma
Skull base neoplasms
Surgical oncology

***Corresponding author:**
Anak Agung Wira Ryantama

E-mail address:
Agungryantama@gmail.com

All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/amcr.v6i3.745

A B S T R A C T

Sinonasal squamous cell carcinoma (SNSCC) is an uncommon malignancy arising within the nasal cavity and paranasal sinuses, representing approximately 3% of head and neck cancers. The non-keratinizing subtype (NKSCC) presents unique diagnostic and therapeutic challenges, particularly when exhibiting locally advanced disease with extension towards critical structures like the skull base. Management typically involves a multimodal approach centered around surgical resection, often followed by adjuvant therapy. We present the case of a 51-year-old female, employed in the wood furniture industry, presenting with a progressively enlarging right nasal mass initially noted four years after removal of a right cheek lesion. Symptoms included unilateral nasal obstruction, epistaxis, anosmia, and loosening of maxillary teeth. Clinical examination revealed a large, friable mass obliterating the right nasal cavity and extending onto the palate. Computed tomography confirmed an extensive destructive mass involving the right nasal cavity, maxillary sinus, ethmoid sinus, extending to the nasopharynx, parapharyngeal space, masticator space, buccal space, frontal sinuses, and abutting the right internal carotid artery. Biopsy confirmed Non-Keratinizing Squamous Cell Carcinoma. The patient was staged as T4bN2cM0 according to the AJCC 8th edition criteria. Following neoadjuvant chemotherapy, the patient underwent total maxillectomy via a Weber-Ferguson approach with Lynch modification, including placement of a dental obturator. In conclusion, advanced NKSCC involving the skull base requires aggressive, multidisciplinary management. This case highlights the necessity of radical surgical resection, such as total maxillectomy via extended approaches like the Weber-Ferguson with Lynch modification, to achieve oncologic control in extensive T4b disease. Despite the challenges posed by proximity to vital structures, surgery remains the cornerstone of treatment, often requiring adjuvant therapy to optimize outcomes. Long-term follow-up is crucial due to the inherent risk of recurrence.

1. Introduction

Sinonasal malignancies represent a rare and heterogeneous group of neoplasms that originate from the epithelial lining or deeper structures of the nasal cavity and paranasal sinuses. These sinuses include the maxillary, ethmoid, sphenoid, and frontal sinuses. Collectively, sinonasal malignancies account for less than 1% of all human cancers. Within the head and neck region, their occurrence is approximately 3-5% of all malignancies. Despite their rarity, these tumors present significant challenges in both diagnosis and treatment. These challenges arise from the complex regional anatomy, the proximity of vital neurovascular structures and sensory organs, and the often-delayed presentation of the disease. The vital neurovascular structures and sensory organs in proximity to

sinonasal malignancies include the orbit, brain, cranial nerves, and carotid arteries. The intricate anatomical confines of the sinonasal tract contribute to the insidious growth and extension of tumors before overt clinical symptoms become apparent. The sinonasal tract is bordered by the orbit superiorly and laterally, the oral cavity inferiorly, the nasopharynx posteriorly, and the anterior cranial fossa superiorly. This anatomical arrangement facilitates tumor growth and extension, often leading to a substantial proportion of patients presenting with locally advanced disease at the time of initial diagnosis. Locally advanced disease frequently involves adjacent structures, complicating curative-intent therapy. The incidence of sinonasal cancers demonstrates geographical variation. Higher rates are reported in parts of Asia and Africa compared to North America and Europe. In certain Asian populations, sinonasal malignancy ranks as the second most common head and neck cancer, following nasopharyngeal carcinoma. The peak incidence of sinonasal cancers typically occurs in individuals between 50 and 70 years of age. There is a notable male predominance, often cited as approximately 2:1 over females. Squamous cell carcinoma (SCC) is the most prevalent histological subtype, accounting for 50-70% of all sinonasal malignancies. The maxillary sinus is the most common site of origin, observed in 60-80% of cases. This is followed by the nasal cavity (20-30%), ethmoid sinuses (10-15%), and rarely, the sphenoid and frontal sinuses (<1%).[1-4]

The etiology of sinonasal SCC is multifactorial and not completely understood. However, significant associations with specific occupational and environmental exposures have been established. Chronic exposure to industrial inhalants is a major risk factor. Notably, exposure to wood dust, particularly from hardwoods, is strongly linked to the development of sinonasal adenocarcinoma, especially the intestinal type (ITAC). Other implicated occupational exposures include nickel refining, leather tanning, textile manufacturing, chromium, isopropyl oils, and formaldehyde. The latency period between initial exposure and tumor development can be prolonged, often spanning decades. For example, the latency period for wood dust exposure can be up to 40 years. The risk of tumor development may persist even after the cessation of exposure. Lifestyle factors such as tobacco smoking and alcohol consumption, well-established carcinogens for other head and neck SCCs, are also considered risk factors for sinonasal SCC. However, the association may be less pronounced than for oropharyngeal or laryngeal cancers. Diets high in salted or smoked foods have also been implicated as potential risk factors. Chronic inflammation, such as long-standing sinusitis, and viral infections, particularly Human Papillomavirus (HPV), have been investigated in relation to sinonasal SCC. While HPV, especially high-risk subtypes, is a known driver of a significant subset of oropharyngeal SCCs, its role in non-keratinizing sinonasal SCC (NKSCC) is more complex. The role of HPV appears relevant in specific subtypes, though less consistently than in the oropharynx. Genetic alterations, including mutations in genes like TP53, and overexpression of growth factor receptors like EGFR or HER2, have been identified, particularly in ITAC associated with wood dust. These findings suggest molecular pathways involved in tumorigenesis.[5-7]

Sinonasal SCC is broadly classified into keratinizing (KSCC) and non-keratinizing (NKSCC) subtypes, along with rarer variants like basaloid, verrucous, and spindle cell carcinoma. KSCC resembles typical SCC found elsewhere in the upper aerodigestive tract. It is characterized by invasive nests of polygonal cells with eosinophilic cytoplasm, intercellular bridges, and keratin pearl formation. NKSCC, also referred to historically as transitional cell carcinoma or Schneiderian carcinoma, represents a distinct entity. Morphologically, NKSCC often resembles non-keratinizing carcinomas of the nasopharynx or oropharynx. It typically displays a

growth pattern of interconnected ribbons, lobules, or large nests of tumor cells infiltrating the stroma, sometimes with minimal desmoplastic reaction. The tumor cells in NKSCC are generally more uniform than in KSCC. They often exhibit a higher nuclear-to-cytoplasmic ratio, vesicular or hyperchromatic nuclei, and indistinct cell borders. Significant keratinization is absent by definition, although focal minimal squamous maturation might be observed. Mitotic activity and apoptosis can be prominent. A characteristic feature, sometimes seen, is an "inverted" growth pattern where tumor nests appear to push into the stroma with rounded contours, potentially mimicking Schneiderian papilloma. Immunohistochemistry typically shows positivity for cytokeratins (like CK5/6) and p40/p63, confirming squamous differentiation. Distinguishing NKSCC from other sinonasal malignancies, particularly neuroendocrine carcinomas or lymphomas (other "small blue round cell tumors"), is crucial. This often relies on morphology combined with a panel of immunohistochemical markers. While some NKSCC cases are associated with HPV, many are HPV-negative. Prognostically, NKSCC has sometimes been reported to have a slightly better outcome compared to KSCC, although this remains debated and heavily influenced by stage and treatment. Despite aggressive multimodal therapy, locoregional recurrence remains a significant challenge.[8-10] This case report details the management of a patient with locally advanced (T4bN2cM0) non-keratinizing sinonasal squamous cell carcinoma involving skull base structures. The treatment included total maxillectomy via a Weber-Ferguson approach with Lynch modification. This report highlights the complexities and strategies involved in treating such challenging presentations.

2. Case Presentation

The patient in this case is a 51-year-old female. This age places her within the typical age range for the development of sinonasal malignancies, which often present in individuals between the fifth and seventh decades of life. While sinonasal cancers, including squamous cell carcinomas, can occur at any age, the peak incidence is observed in this demographic. Understanding the patient's age is critical as it informs the differential diagnosis and the overall management strategy. Age can also influence treatment tolerance and prognosis, with older patients potentially facing increased risks of comorbidities and reduced physiological reserve. The patient's residence is documented as Benoa, Indonesia. Geographical location is a significant factor in epidemiological studies of cancer, as the incidence and prevalence of specific malignancies can vary considerably across different regions. Environmental exposures, dietary habits, genetic predispositions, and access to healthcare can all contribute to these variations. In particular, certain regions in Asia have reported higher rates of sinonasal malignancies compared to Western countries. This geographical context is crucial for understanding the potential etiological factors in this patient's case, particularly concerning environmental and occupational exposures prevalent in her region. The patient's occupation is listed as an employee in the wood furniture industry. This occupational history is of paramount importance, as exposure to wood dust is a well-established risk factor for certain types of sinonasal cancers, most notably sinonasal adenocarcinoma, particularly the intestinal type adenocarcinoma (ITAC). While the patient was diagnosed with squamous cell carcinoma, the potential influence of wood dust exposure cannot be entirely dismissed. Chronic irritation and inflammation from wood dust, or potential co-carcinogenic effects, may contribute to the development of squamous cell carcinoma, even if the primary association is with adenocarcinoma. The duration and intensity of wood dust exposure, as well as the specific types of wood involved, are important factors to consider, though not detailed in the provided table. A thorough occupational history is essential in

all cases of sinonasal malignancy. The patient's chief complaints centered around a progressively enlarging right nasal mass. This symptom is a hallmark of sinonasal tumors, often indicating a gradual increase in size and obstruction within the nasal cavity. The progressive nature of the enlargement is crucial, as it distinguishes neoplastic processes from acute inflammatory conditions. Accompanying the nasal mass was severe bilateral nasal obstruction. This bilateral obstruction, despite the unilateral origin of the mass, suggests significant mass effect, with the tumor growing to a size that impedes airflow in both nasal passages. Nasal obstruction is a common symptom in sinonasal cancers, resulting from the physical blockage of the nasal cavity by the tumor. It can lead to significant discomfort and functional impairment, affecting breathing and quality of life. The severity of the obstruction in this case highlights the advanced nature of the tumor. Intermittent bilateral epistaxis (nosebleeds) was also reported. Epistaxis is another frequent symptom of sinonasal malignancies. The friable nature of tumor tissue and its increased vascularity make it prone to bleeding. Bilateral epistaxis, as seen in this case, can be due to the tumor extending across the midline or causing significant irritation and inflammation in both nasal cavities. The intermittent nature of the bleeding suggests that it is not a constant, profuse hemorrhage, but rather episodes of bleeding related to minor trauma or tumor disruption. Anosmia, or loss of smell, was a significant symptom. The olfactory epithelium, responsible for the sense of smell, is located in the nasal cavity. Tumors in this region can directly damage or obstruct the olfactory pathways, resulting in anosmia. Anosmia can have a profound impact on a patient's quality of life, affecting their ability to enjoy food, detect odors, and perceive environmental cues. Loosening of the right upper teeth and difficulty chewing (mastication) were also prominent complaints. These symptoms indicate the tumor's extension into the maxillary region, involving the alveolar process and potentially the palate. The loosening of teeth suggests bone invasion and destruction, a characteristic feature of aggressive sinonasal malignancies. Difficulty chewing further emphasizes the functional impairment caused by the tumor's growth. The patient's history of present illness reveals that the symptoms began circa 2020 with a small right intranasal growth. This insidious onset is typical of many sinonasal tumors, which can initially present with subtle and easily overlooked symptoms. The four-year interval between the initial symptom onset and presentation underscores the potential for delayed diagnosis in these malignancies. The history also includes a prior excision of a right cheek lesion in 2016. The potential relationship between this previous lesion and the current sinonasal tumor needs careful consideration, although the table does not provide histological details of the cheek lesion. It is possible that they are unrelated, or that the cheek lesion represents an earlier manifestation of the same underlying malignancy, or a separate primary tumor. The patient reported that the intranasal growth progressively enlarged, eventually causing left nasal obstruction and right facial swelling. This progression highlights the aggressive growth pattern of the tumor and its ability to invade and distort surrounding structures. The facial swelling indicates significant tumor volume and extension beyond the nasal cavity itself. There was a sensation of extension into the right upper jaw, correlating with the reported loosening of teeth and chewing difficulties. This symptom further emphasizes the tumor's invasive nature and its involvement of the maxillary bone and surrounding tissues. The review of systems is important for excluding other potential causes of the patient's symptoms and for assessing the overall impact of the disease. The patient specifically denied experiencing severe headache, tinnitus, otalgia (ear pain), diplopia (double vision), proptosis (eye protrusion), epiphora (excessive tearing), oral discharge (blood or pus), neck/axillary/inguinal lumps, shortness of breath, or fever. The absence of severe headache, cranial nerve

symptoms (diplopia, proptosis), and neurological symptoms is important for assessing the extent of tumor invasion, particularly concerning the skull base and intracranial involvement. The denial of neck lumps is notable, although imaging revealed cervical lymphadenopathy. The absence of shortness of breath and fever helps to rule out significant systemic involvement or infection. The patient confirmed the sensation of loose right upper teeth and reported that swallowing was intact for soft foods, with taste sensation preserved. The ability to swallow soft foods suggests that the tumor, while causing difficulty chewing, has not significantly compromised the oropharyngeal function. The preservation of taste is also notable, although the table does not elaborate on the specific aspects of taste that were assessed. The patient's past medical history includes a previous surgery: excision of a right cheek lesion in 2016. As mentioned earlier, the nature and histology of this lesion are critical pieces of information that are not provided in the table. Understanding whether this was a benign or malignant lesion, and if malignant, its histological type, is crucial for determining its potential relationship to the current sinonasal tumor. The patient had also undergone oncologic treatment, completing the second series of chemotherapy and the first cycle of targeted therapy in November 2023. This history of prior treatment is highly significant. It indicates that the patient had already been diagnosed with a malignancy and had received systemic therapy. The specific chemotherapy agents and targeted therapies used are not detailed in the table, but this information is essential for understanding the patient's treatment history and potential treatment resistance. The fact that the patient had received prior treatment also influences treatment planning, as it may affect treatment tolerance and potential side effects. The patient reported no history of hypertension or diabetes mellitus. This information is relevant for assessing the patient's overall health status and identifying potential comorbidities that may influence surgical risks and treatment decisions. The patient is a non-smoker and non-drinker. While tobacco and alcohol are significant risk factors for many head and neck cancers, their absence in this patient's history suggests that these factors are unlikely to have played a major role in the development of her sinonasal malignancy. Her diet is characterized by frequent consumption of preserved and grilled foods. Dietary factors have been implicated in the etiology of some cancers. Preserved foods, particularly those that are salted or smoked, may contain carcinogens. Grilled foods can also contain heterocyclic amines and polycyclic aromatic hydrocarbons, which are known carcinogens. The frequent consumption of these types of foods may represent a contributing risk factor, although the evidence linking them directly to sinonasal squamous cell carcinoma is not as strong as for other head and neck cancers. As previously mentioned, the patient's occupational exposure is significant: she is an employee in the wood furniture industry. The potential impact of chronic wood dust exposure has been discussed in detail above. The patient reported no family history of similar malignancies. While some cancers have a strong hereditary component, the majority of sinonasal cancers are sporadic, meaning they arise without a clear familial predisposition. However, a detailed family history is always important in cancer evaluation. The patient's general appearance was described as "compos mentis, adequately nourished." "Compos mentis" indicates that the patient was alert and oriented, with no signs of altered mental status. The "adequately nourished" description suggests that the patient had not experienced significant weight loss or nutritional deficiencies, which can be associated with advanced malignancies. Her vital signs were stable: blood pressure 120/90 mmHg, respiratory rate 20 breaths/minute, heart rate 88 beats/minute, temperature 37.0°C, and oxygen saturation 99% on room air. Stable vital signs are important indicators of overall physiological function and suggest that the

patient was not in acute distress. The head and neck examination revealed several significant abnormalities. There was visible asymmetry, with prominent right cheek swelling and distortion of the nasal structure. This asymmetry and swelling are consistent with the patient's chief complaint of a progressively enlarging nasal mass and indicate significant tumor volume and extension. The distortion of the nasal structure suggests that the tumor has altered the normal anatomy of the nose. Palpation over the right zygomatic region revealed a firm, non-tender mass, approximately 5x6 cm in size, with well-defined borders, fixed to the base, and without fluctuation. The size and location of this mass correlate with the facial swelling. The firmness and fixation of the mass are concerning for malignancy, as benign masses are often mobile and soft. The lack of tenderness suggests that the mass is not acutely inflamed. The absence of fluctuation indicates that the mass is solid, rather than cystic. Anterior rhinoscopy was limited, but a fleshy, friable-appearing mass, which bled easily on contact, was seen completely filling the right nasal cavity and extending towards the left, severely narrowing the left nasal passage. This finding confirms the presence of a substantial tumor within the nasal cavity. The friability and easy bleeding of the mass are typical characteristics of malignant tumors. The extension of the tumor to the left and the severe narrowing of the left nasal passage further demonstrate its aggressive growth and mass effect. Intraoral examination revealed a significant mass lesion on the right hard palate, measuring approximately 3x2 cm. This finding indicates that the tumor has extended inferiorly into the oral cavity, involving the palate. The mass had an irregular, nodular surface, was firm, fixed to the underlying bone, non-tender, and showed evidence of contact bleeding but no active hemorrhage. These characteristics are consistent with malignancy. The overlying palatal mucosa appeared intact but possibly erythematous (reddened), suggesting inflammation or irritation. Mobility of the right maxillary dentition was noted, further supporting the tumor's involvement of the maxillary bone. Nasoendoscopy provided further detailed evaluation of the nasal cavity. The right nasal cavity was completely obliterated by a large tumor mass, preventing further evaluation of structures like the turbinates, septum, or mucosa. This confirms the extent of the tumor's growth and its destructive effect on the nasal cavity. The left nasal cavity was markedly narrowed due to mass effect from the right side, pushing the septum contralaterally. This finding explains the patient's bilateral nasal obstruction, despite the unilateral origin of the tumor. Evaluation of the turbinates, septum, and mucosa was hindered bilaterally by the tumor bulk, highlighting the difficulty in assessing the normal nasal anatomy due to the tumor. The complete blood count (CBC) revealed a white blood cell count (WBC) of 8.5 x 10^3/L (Normal Range: 4.0-11.0), hemoglobin (Hb) of 11.8 g/dL (NR: 12.0-16.0), hematocrit (Hct) of 35.5% (NR: 36-48), and platelets of 250 x 10^3/L. The WBC count is within the normal range, suggesting no significant systemic infection. However, the Hb and Hct levels are slightly below the normal range, indicating borderline anemia. Anemia can be associated with chronic disease and may warrant further investigation. The platelet count is within the normal range. The basic metabolic panel showed sodium of 140 mmol/L (NR: 135-145), potassium of 4.2 mmol/L (NR: 3.5-5.0), chloride of 102 mmol/L (NR: 98-108), CO_2 of 24 mmol/L (NR: 22-30), blood urea nitrogen (BUN) of 15 mg/dL (NR: 7-20), creatinine of 0.9 mg/dL (NR: 0.6-1.2), and glucose of 95 mg/dL (NR: 70-100). All values are within normal limits, indicating normal renal function, electrolyte balance, and glucose metabolism. The liver function tests (LFTs) showed aspartate transaminase (AST) of 25 U/L (NR: <40), alanine transaminase (ALT) of 30 U/L (NR: <40), alkaline phosphatase (Alk Phos) of 80 U/L (NR: 40-130), and total bilirubin of 0.7 mg/dL (NR: 0.2-1.2). All values are within normal limits, suggesting normal liver function. The coagulation

studies showed prothrombin time (PT) of 12.5 sec (NR: 11-13.5), partial thromboplastin time (PTT) of 30 sec (NR: 25-35), and international normalized ratio (INR) of 1.0 (NR: <1.1). All values are within normal limits, indicating normal blood clotting function. Contrast-enhanced CT scan of the head revealed a large, irregular, solid, heterogeneously enhancing mass. This description is characteristic of a malignant tumor. The heterogeneous enhancement suggests areas of necrosis and varying vascularity within the tumor. The mass was located in the right nasal cavity, right maxillary sinus, and right ethmoid sinus. This indicates that the tumor originated in the sinonasal region and involved multiple sinuses. The tumor extended into the right nasopharynx, right mucosal/para-pharyngeal/masticator spaces (infiltrating pterygoid and masseter muscles), right oropharynx/tonsil/lingual region, right buccal space, bilateral frontal sinuses, and right sphenoid sinus. This extensive spread demonstrates the aggressive and invasive nature of the tumor. The involvement of the nasopharynx, parapharyngeal and masticator spaces, and oropharynx indicates deep tissue invasion. The infiltration of pterygoid and masseter muscles explains the patient's difficulty chewing. The involvement of bilateral frontal sinuses and right sphenoid sinus demonstrates the tumor's ability to spread beyond its primary site. There was bony destruction of the right pterygoid process(es), right alveolar process, and medial/lateral walls of the right maxillary sinus. Bony destruction is a hallmark of malignancy, indicating that the tumor is invading and destroying bone tissue. The tumor was noted to abut/compress the right internal carotid artery and internal jugular vein. This is a critical finding, as it indicates the tumor's proximity to major blood vessels. Abutment or compression of these vessels can lead to significant complications, such as bleeding or vascular compromise. Multiple suspicious bilateral cervical lymph nodes were identified (Level Ib, IIa/b). Lymph node involvement indicates regional metastasis, meaning the tumor has spread from its primary site to the lymph nodes in the neck. Bilateral involvement suggests a more advanced stage of disease. Other findings included associated acute/chronic sinusitis. Sinusitis can be both a symptom and a consequence of sinonasal tumors. The tumor can obstruct sinus drainage, leading to inflammation and infection. The primary diagnosis was non-keratinizing squamous cell carcinoma (NKSCC). This is a specific histological subtype of squamous cell carcinoma, with distinct morphological and potentially biological characteristics. The location of the tumor was the right sinonasal tract, with the origin likely in the maxillary sinus or nasal cavity, given the extensive spread. Determining the precise site of origin can be challenging in advanced tumors with widespread involvement. The TNM staging, according to the AJCC 8th Edition, was T4b N2c M0. This staging is crucial for determining prognosis and treatment planning. T4b indicates a very advanced primary tumor with invasion of the skull base, pterygoid plates, or encasement of the internal carotid artery. In this case, the tumor's extension into the nasopharynx, pterygoid muscles, and abutment of the internal carotid artery contributed to the T4b designation. N2c indicates bilateral cervical lymph node metastasis, with at least one lymph node measuring greater than 6 cm in greatest dimension. M0 indicates no evidence of distant metastasis. The overall stage was Stage IVB. This is an advanced stage of disease, associated with a poorer prognosis compared to earlier stages (Table 1).

The patient's journey began with the crucial steps of diagnosis and staging, spanning from October 2023 to February 2024. A biopsy was performed, which confirmed the histological diagnosis of non-keratinizing squamous cell carcinoma (NKSCC). Imaging studies, specifically CT scans, played a vital role in defining the extensive nature of the disease, classifying it as T4b with N2c nodal involvement. This staging process culminated in the final determination

of Stage IVB disease, providing a comprehensive understanding of the tumor's extent and informing subsequent treatment decisions. Prior to surgery, the patient underwent neoadjuvant therapy, completed in November 2023. This treatment regimen consisted of two series of chemotherapy and one cycle of targeted therapy. The specific agents employed in this therapy are not detailed in the table, but the administration of neoadjuvant therapy is a significant component of the treatment strategy. Neoadjuvant therapy aims to reduce tumor burden, potentially improve resectability, and address micrometastatic disease. Planning for the surgical intervention occurred pre-surgery, involving multidisciplinary collaboration. Otorhinolaryngology-Head & Neck Surgery (THT-KL) and Dental Surgery teams engaged in a coordinated discussion to plan for the surgical resection and the subsequent prosthetic rehabilitation. This interdisciplinary approach ensured comprehensive management of the patient's oncologic and functional needs. The culmination of these discussions was the decision to proceed with surgical resection as the primary modality for locoregional control. The operative phase took place in February 2024, centered around the surgical procedure itself. The primary procedure was a right total maxillectomy with ethmoidectomy. This extensive surgical intervention was necessary to address the tumor's widespread involvement of the maxilla and ethmoid sinuses. The surgical approach employed was a Weber-Ferguson incision with Lynch modification. This approach provides wide exposure of the surgical field, crucial for achieving complete tumor resection in cases with extensive disease. The Weber-Ferguson incision involves a combination of incisions to access the maxilla and surrounding structures, while the Lynch modification extends the access to the ethmoid and frontal sinus regions. General anesthesia with orotracheal intubation was administered to ensure patient comfort and immobility during the lengthy and complex surgical procedure. Key surgical steps included the incision along the Weber-Ferguson line, incorporating the Lynch extension to maximize exposure. Subperiosteal elevation of the cheek flap was performed to expose the underlying bony structures. Osteotomies, or bone cuts, were made in the zygoma, frontal process, orbital floor, and hard palate to facilitate the removal of the maxilla. The resection involved the en bloc removal of the maxilla, with the identification and removal of the extensive, fragile, and vascular tumor that filled the maxillary and ethmoid sinuses and nasal cavity. Clearance towards the skull base was performed via ethmoidectomy, addressing the superior extension of the tumor. Transection of the pterygoid plates was necessary, requiring meticulous hemostasis to manage the associated bleeding. Hemostasis, or control of bleeding, was achieved through various methods, including packing, bipolar cautery, and suture ligatures. Reconstruction was initiated intra-operatively with the immediate placement of a surgical obturator prosthesis by the Dental Surgery team. The obturator plays a critical role in separating the oral and nasal cavities, supporting soft tissues, and facilitating speech and swallowing post-operatively. Closure and packing of the surgical site were performed following tumor removal. The wound was closed over the defect and obturator, and the surgical site, likely the nasal and maxillary cavity, was packed with antibiotic-impregnated gauze to control bleeding and prevent infection. The immediate post-operative phase spanned from Post-Operative Day (POD) 0 to POD 3, characterized by close monitoring and management of the patient. For POD 0-1, the patient was admitted to the Intensive Care Unit (ICU). The ICU setting allowed for intensive monitoring and support in the immediate aftermath of major surgery. On POD 2-3, the patient was transferred to a regular surgical ward, indicating a stable condition that allowed for less intensive monitoring. Monitoring was continuous, encompassing vital signs, neurological status, airway assessment, and monitoring for bleeding or

cerebrospinal fluid (CSF) leak. Given the proximity of the surgery to the skull base, monitoring for CSF leak was particularly important. Airway assessment was crucial to ensure adequate respiratory function. Management focused on pain control, nutrition, medication administration, and wound care. Pain was reported as minimal and managed with analgesia, specifically Paracetamol. Nutrition was provided via a nasogastric tube (NGT), ensuring adequate caloric and fluid intake during the initial recovery period. Intravenous medications were administered, including Ceftriaxone (1g q12h) for antibiotic coverage and Tranexamic Acid (500mg q8h) for hemostasis. Wound care involved checking the packing and obturator, with minimal drainage noted. Significant milestones during this phase included the removal of the anterior nasal packing on POD 2, with no active bleeding observed. On POD 3, the patient was discharged home with medications administered via the NGT, indicating sufficient stability for outpatient management. Short-term follow-up occurred on POD 7 with a clinic visit. The patient reported no significant complaints, indicating a relatively smooth initial recovery. Wound care was provided, focusing on incision sites and the intraoral cavity around the obturator. The NGT was removed, and the patient transitioned to oral intake, with a soft diet advised to minimize stress on the surgical site. Oral Paracetamol was prescribed for ongoing analgesia. Patient education was provided on wound care and obturator hygiene, empowering the patient to participate in their recovery. The adjuvant therapy phase was planned to commence approximately three weeks post-operatively. This phase is critical due to the advanced stage of the disease. A post-operative consultation was scheduled to finalize the adjuvant therapy plan. The planned modality was likely concurrent chemoradiation (CRT), considered standard for high-risk features such as T4b disease and N2c nodal involvement. CRT requires multidisciplinary planning, involving collaboration among Surgery, Medical Oncology, and Radiation Oncology. Radiotherapy was planned for approximately 6-7 weeks duration. The target volume included the resection bed, encompassing the maxillectomy cavity and skull base interface, and bilateral neck nodal basins (Levels Ib, II, III, and potentially IV/V) to address potential residual disease and nodal involvement. The planned dose was approximately 60-66 Gy, delivered in daily fractions. The technique employed was likely Intensity-Modulated Radiation Therapy (IMRT), designed to spare critical structures such as the brain, contralateral eye, and optic nerves, minimizing treatment-related toxicity. Chemotherapy was planned to be administered concurrently with radiotherapy. Cisplatin, either weekly at a low dose or every three weeks at a high dose, is a common standard agent used in this setting. The goal of concurrent chemotherapy is to act as a radiosensitizer, enhancing the effectiveness of radiation therapy, and to provide systemic control, addressing any potential micrometastatic disease. Long-term follow-up is essential for monitoring recurrence and managing potential complications. The schedule for follow-up varies over time. During Year 1-2, follow-up is planned every 1-3 months, involving clinical examination and nasal endoscopy to assess for local recurrence and treatment-related complications. Imaging studies, specifically CT or MRI of the head and neck, are scheduled every 3-6 months to monitor for locoregional recurrence or distant metastasis. In Year 3-5, the frequency of follow-up decreases to every 4-6 months for clinical examination and nasal endoscopy. Imaging is performed annually. Beyond 5 years, follow-up is planned annually or as indicated by symptoms or clinical findings, with clinical examination, nasal endoscopy, and imaging performed as needed. The methods employed in long-term follow-up include clinical assessment to monitor for symptoms of recurrence and treatment sequelae, nasal endoscopy to inspect the resection cavity and obturator interface, and imaging (CT/MRI) for

surveillance of locoregional recurrence or distant metastasis. PET/CT may be used if recurrence is suspected. Regular dental and prosthodontic checks are also included to monitor, clean, and potentially adjust or remake the obturator. The expected status at 1-year post-treatment, assuming successful treatment, is no evidence of disease recurrence on clinical examination and imaging. Management of expected sequelae, such as facial numbness, dry eye/epiphora, and potential cosmetic changes, is anticipated. Stable obturator function, allowing adequate speech and swallowing, is also an expected outcome (Table 2).

Table 1. Summary of patient's clinical findings.

Category	Finding details
Demographics	
Age	51 years
Gender	Female
Residence	Benoa, Indonesia
Occupation	Employee in the wood furniture industry
Anamnesis (History)	
Chief complaints	Progressively enlarging right nasal mass, severe bilateral nasal obstruction, intermittent bilateral epistaxis, anosmia (loss of smell), loosening of right upper teeth, difficulty chewing.
History of present illness	Symptoms began circa 2020 with a small right intranasal growth, 4 years after excision of a right cheek lesion (2016). Progressive enlargement leading to current complaints. Mass effect causing left nasal obstruction and right facial swelling. Sensation of extension into the right upper jaw.
Review of systems	Denied: Severe headache, tinnitus, otalgia, diplopia, proptosis, epiphora, oral discharge (blood/pus), neck/axillary/inguinal lumps, shortness of breath, fever.
	Confirmed: Sensation of loose right upper teeth. Swallowing intact for soft foods, taste intact.
Past medical history	- Previous surgery: Excision of right cheek lesion (2016).
	- Oncologic treatment: Completed 2nd series chemotherapy + 1st cycle targeted therapy (Nov 2023).
	- No history of hypertension or diabetes mellitus.
Social history	- Non-smoker, non-drinker.
	- Diet: Frequent consumption of preserved and grilled foods.
	- Occupational exposure: Potential chronic wood dust exposure.
Family history	No family history of similar malignancies reported.
Physical examination	
General appearance	Compos mentis, adequately nourished.
Vital signs	BP: 120/90 mmHg, RR: 20/min, HR: 88/min, Temp: 37.0°C, SpO_2: 99% (RA).
Head & neck	- Face: Visible asymmetry, prominent right cheek swelling, distorted nasal structure.
	- Right Zygoma: Palpable firm, non-tender mass, approx. 5x6 cm, well-defined, fixed to base, no fluctuation.
	- Nose (Anterior Rhinoscopy): Right nasal cavity completely obstructed by fleshy, friable, easily bleeding mass. Left nasal cavity severely narrowed by mass effect.
	- Oral Cavity: Right hard palate with 3x2 cm firm, fixed, nodular, non-tender mass with contact bleeding. Right maxillary teeth mobile.
	- Neck: No palpable cervical lymphadenopathy (Note: Imaging showed nodes).
	- Ears/Oropharynx: Unremarkable.
Nasoendoscopy	- Right Nasal Cavity: Obliterated by tumor, structures not visualized.
	- Left Nasal Cavity: Markedly narrowed by mass effect, detailed evaluation difficult.
	- Other Structures: Turbinates, septum, mucosa largely unevaluable due to tumor bulk.
Laboratory findings	
Complete blood count	WBC: 8.5 x 10^3/L (Normal Range: 4.0-11.0), Hb: 11.8 g/dL (NR: 12.0-16.0), Hct: 35.5% (NR: 36-48), Platelets: 250 x 10^3/L (NR: 150,000-450,000). (Suggests borderline anemia, otherwise normal)
Basic metabolic panel	Sodium: 140 mmol/L (NR: 135-145), Potassium: 4.2 mmol/L (NR: 3.5-5.0), Chloride: 102 mmol/L (NR: 98-108), CO_2: 24 mmol/L (NR: 22-30), BUN: 15 mg/dL (NR: 7-20), Creatinine: 0.9 mg/dL (NR: 0.6-1.2), Glucose: 95 mg/dL (NR: 70-100). (Within normal limits)
Liver function tests	AST: 25 U/L (NR: <40), ALT: 30 U/L (NR: <40), Alk Phos: 80 U/L (NR: 40-130), Total Bilirubin: 0.7 mg/dL (NR: 0.2-1.2). (Within normal limits)
Coagulation studies	PT: 12.5 sec (NR: 11-13.5), PTT: 30 sec (NR: 25-35), INR: 1.0 (NR: <1.1). (Within normal limits)
Imaging findings	
CT-scan (Contrast)	- Large, irregular, solid, heterogeneously enhancing mass.
	- Location: Filling right nasal cavity, right maxillary sinus, right ethmoid sinus.
	- Extension: Right nasopharynx, right mucosal/para-pharyngeal/masticator spaces (infiltrating pterygoid & masseter muscles), right oropharynx/tonsil/lingual region, right buccal space, bilateral frontal sinuses, right sphenoid sinus.
	- Bony Destruction: Right pterygoid process(es), right alveolar process, medial/lateral walls of right maxillary sinus.
	- Neurovascular: Abutting/compressing right Internal Carotid Artery & Internal Jugular Vein.
	- Lymph Nodes: Multiple suspicious bilateral cervical nodes (Level Ib, IIa/b).
	- Other: Associated acute/chronic sinusitis.
Clinical diagnosis	
Primary diagnosis	Non-Keratinizing Squamous Cell Carcinoma (NKSCC)
Location	Right Sinonasal Tract (origin likely maxillary sinus or nasal cavity with extensive spread)
TNM staging (AJCC 8th Ed)	T4b N2c M0
Overall stage	Stage IVB

Table 2. Summary of treatment procedures and follow-up.

Phase	Time Point / Detail	Description
Pre-operative phase		
Diagnosis & staging	October 2023 - February 2024	- Biopsy Confirmed: Non-Keratinizing Squamous Cell Carcinoma (NKSCC).
		- Imaging (CT-Scan): Defined extensive T4b disease with N2c nodal involvement.
		- Staging: Finalized as Stage IVB (T4bN2cM0).
Neoadjuvant therapy	Completed November 2023	Patient completed 2 series of chemotherapy and 1 cycle of targeted therapy (Specific agents not detailed in source).
Planning	Pre-Surgery	Multidisciplinary discussion involving Otorhinolaryngology-Head & Neck Surgery (THT-KL) and Dental Surgery (for obturator planning). Decision for surgical resection.
Operative phase	**February, 2024**	
Procedure		**Right Total Maxillectomy with Ethmoidectomy**
Surgical approach		**Weber-Ferguson incision with Lynch modification**
Anesthesia		General anesthesia with orotracheal intubation.
Key surgical steps		- Incision: Weber-Ferguson line combined with Lynch extension.
		- Exposure: Subperiosteal elevation of cheek flap.
		- Osteotomies: Zygoma, frontal process, orbital floor, hard palate.
		- Resection: En bloc removal of maxilla, extensive fragile/vascular tumor identified filling maxillary/ethmoid sinuses and nasal cavity. Clearance towards the skull base via ethmoidectomy. Pterygoid plate transection with hemostasis.
		- Hemostasis: Packing, bipolar cautery, suture ligatures as needed.
Reconstruction	Intra-operative	Immediate placement of surgical **obturator prosthesis** by Dental Surgery team.
Closure / Packing		Wound closure over defect/obturator. Surgical site packed (likely nasal/maxillary cavity with antibiotic-impregnated gauze).
Immediate post-operative phase	**POD 0 - POD 3**	
Location	POD 0-1	Intensive Care Unit (ICU) admission.
	POD 2-3	Transfer to regular surgical ward.
Monitoring	Continuous	Vital signs, neurological status, airway assessment, monitoring for bleeding or CSF leak (implied due to skull base proximity).
Management		- Pain: Minimal pain reported, managed with analgesia (Paracetamol).
		- Nutrition: Nasogastric Tube (NGT) feeding.
		- Medications (IV): Ceftriaxone 1g q12h, Tranexamic Acid 500mg q8h.
		- Wound Care: Packing and obturator checked, minimal drainage noted.
Milestones	POD 2	Anterior nasal packing removed (no active bleeding).
	POD 3	Patient discharged home with medications via NGT.
Short-term follow-up	**POD 7**	
Visit	Clinic Visit	- Patient reported no significant complaints.
		- Wound care provided (incision sites, intraoral cavity).
		- NGT removed, transitioned to oral intake (soft diet advised).
		- Oral Paracetamol prescribed.
		- Education on wound care and obturator hygiene provided.
Adjuvant therapy phase (Planned)	**Starting ~3 Weeks Post-Op**	
Plan	Post-operative consultation	Plan to resume/initiate adjuvant therapy due to advanced stage (T4bN2cM0).
Modality	Likely Concurrent Chemoradiation (CRT)	Standard for high-risk features (T4b, N2c). Requires multidisciplinary planning (Surgery, Medical Oncology, Radiation Oncology).
Radiotherapy	~6-7 weeks duration	- Target Volume: Resection bed (maxillectomy cavity, skull base interface) and bilateral neck nodal basins (Levels Ib, II, III, potentially IV/V).
		- Dose: ~60-66 Gy in daily fractions.
		- Technique: Intensity-Modulated Radiation Therapy (IMRT) to spare critical structures (brain, contralateral eye, optic nerves).
Chemotherapy	Concurrent with RT	- Agent: Cisplatin (weekly low-dose or 3-weekly high-dose) is a common standard.
		- Goal: Radiosensitization, systemic control.
Long-term follow-up	**Ongoing from Adjuvant Therapy Completion**	
Schedule	Year 1-2	Every 1-3 months: Clinical exam, nasal endoscopy.
		Every 3-6 months: Imaging (CT/MRI head/neck).
	Year 3-5	Every 4-6 months: Clinical exam, nasal endoscopy.
	Beyond 5 years	Annually: Imaging.
		Annually or as indicated: Clinical exam, nasal endoscopy, imaging.
Methods		- Clinical Assessment: Monitor for symptoms of recurrence, treatment sequelae.
		- Nasal Endoscopy: Inspect resection cavity/obturator interface.
		- Imaging (CT/MRI): Surveillance for locoregional recurrence or distant metastasis. PET/CT if recurrence suspected.
		- Dental/Prosthodontic: Regular checks, cleaning, potential adjustments or remakes of the obturator.
Expected status	1 Year Post-Treatment	Assuming successful treatment: No evidence of disease recurrence on clinical exam and imaging. Managing expected sequelae (facial numbness, dry eye/epiphora, potential cosmetic changes). Stable obturator function allowing adequate speech and swallowing.

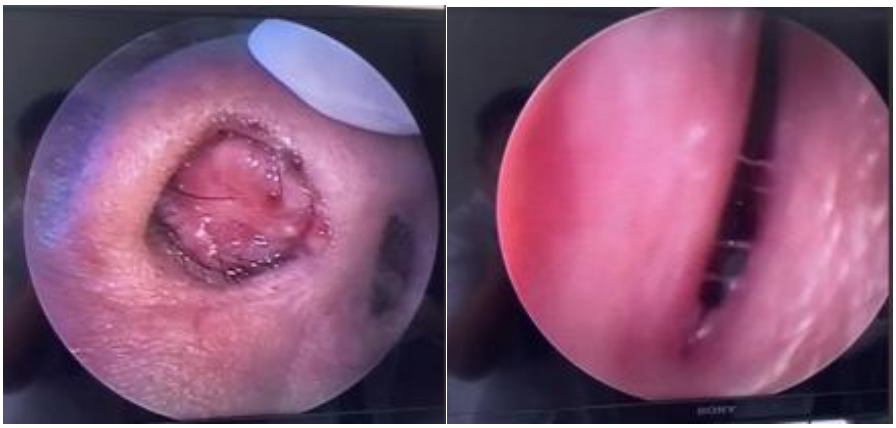

Figure 1. Nasoendoscopic evaluation.

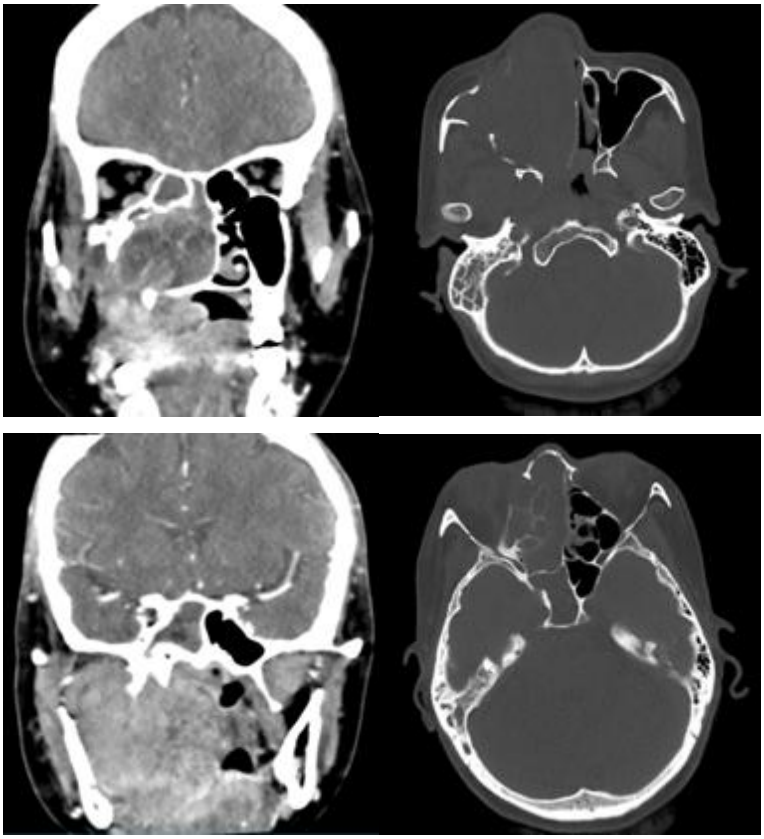

Figure 2. CT scan of the head, focusing on the paranasal sinuses (axial; coronal planes with contrast).

3. Discussion

The initial symptoms experienced by the patient, such as unilateral nasal obstruction, epistaxis, and anosmia, are common but often non-specific manifestations of sinonasal tumors. These symptoms can easily be mistaken for benign inflammatory conditions like chronic rhinosinusitis or nasal polyposis, leading to potential delays in diagnosis. The insidious onset and gradual progression of these symptoms, as observed in this case, are characteristic of sinonasal malignancies. As the tumor progresses, it can invade adjacent structures, resulting in a wider

range of more specific and alarming symptoms. In this patient, the extension of the tumor led to palatal involvement with tooth mobility and significant facial swelling. These findings underscore the importance of a thorough clinical examination and a high index of suspicion in patients presenting with persistent sinonasal symptoms. The patient's occupational history as an employee in the wood furniture industry is a notable risk factor. While wood dust exposure is more strongly associated with sinonasal adenocarcinoma, particularly the intestinal type, its potential contribution to the development of squamous cell carcinoma cannot be entirely ruled out. The latency period between wood dust exposure and tumor development can be prolonged, sometimes spanning decades, and the risk may persist even after exposure cessation. In this case, the chronic exposure to wood dust might have played a role in the tumorigenesis, although further investigations into specific wood types and exposure levels would be needed to establish a definitive link.[11-13]

The diagnosis of non-keratinizing squamous cell carcinoma (NKSCC) in this patient is an important histopathological finding. NKSCC is a distinct subtype of sinonasal squamous cell carcinoma, with unique morphological features compared to the more common keratinizing squamous cell carcinoma (KSCC). NKSCC is characterized by a lack of significant keratinization, often exhibiting a growth pattern of interconnected ribbons or lobules of tumor cells. The cells in NKSCC tend to be more uniform, with a higher nuclear-to-cytoplasmic ratio. While some NKSCC cases are associated with human papillomavirus (HPV) infection, many are HPV-negative. Accurate histological subtyping is crucial, as treatment responses and prognosis can differ between NKSCC and KSCC. Immunohistochemical staining, typically showing positivity for cytokeratins and p40/p63, plays a vital role in confirming the squamous differentiation and distinguishing NKSCC from other sinonasal malignancies.[14-16]

Radiological imaging is indispensable in the evaluation and management of sinonasal malignancies. In this case, contrast-enhanced Computed Tomography (CT) scans were utilized to define the extent of the tumor. CT provides excellent delineation of bony structures, which is crucial for assessing tumor invasion into the sinus walls, orbit, palate, and skull base. The CT findings in this case revealed extensive tumor involvement, including multiple sinuses (maxillary, ethmoid, frontal, sphenoid), deep spaces (nasopharynx, parapharyngeal, masticator, buccal), and bony destruction. Notably, the tumor abutted the right internal carotid artery, a critical finding that significantly influences surgical planning and prognosis. Based on the clinical and radiological findings, the patient was staged as T4bN2cM0 according to the AJCC 8th edition criteria. This staging system is the standard for classifying the extent of sinonasal cancers and is essential for guiding treatment decisions and predicting prognosis. The T4b designation indicates a very advanced tumor with invasion of the skull base, pterygoid plates, or encasement of the internal carotid artery. The N2c classification reflects bilateral cervical lymph node involvement. The M0 designation indicates no evidence of distant metastasis at the time of evaluation. While CT provides valuable information about bony involvement, Magnetic Resonance Imaging (MRI) offers superior soft tissue contrast, allowing for better delineation of tumor margins, perineural spread, and intracranial extension. Although not explicitly detailed in the provided report, the use of MRI would typically complement CT in assessing advanced sinonasal malignancies.[17-20]

4. Conclusion

This case report illustrates the complex management of a patient with advanced non-keratinizing sinonasal squamous cell carcinoma (NKSCC) involving the skull base. The patient's

presentation with progressive nasal obstruction, epistaxis, and involvement of surrounding structures highlights the aggressive nature of these tumors and the challenges in achieving local control. The surgical approach, utilizing a total maxillectomy via the Weber-Ferguson incision with Lynch modification, demonstrates the extent of resection often required for T4b disease. The involvement of the skull base and proximity to critical structures such as the internal carotid artery underscore the need for meticulous surgical planning and execution. This case also emphasizes the importance of a multidisciplinary approach, integrating surgical intervention with neoadjuvant and adjuvant therapies, including chemotherapy and radiation. Furthermore, the role of long-term follow-up is crucial for monitoring recurrence and managing potential complications.

5. References

1. Das B, Pandharpurkar M. Non-keratinizing squamous cell carcinoma – A rare variant of sinonasal tract malignancy invading orbit: a case report and review of literature. Indian J Ophthalmol Case Rep. 2024; 4(3): 638–41.
2. Costantino A, Haughey B, Zhu J, Mekhail T, Kandula S, Alamoudi U, et al. Sinonasal squamous cell carcinoma in the United States: Temporal and geographic patterns associated with HPV testing and positivity. Oral Oncol. 2024; 154(106855): 106855.
3. Poutoglidis A, Georgalas C, Fyrmpas G, Karamitsou P. What is the rate of occult nodal metastasis in squamous cell carcinomas of the sinonasal tract? A systematic review. Eur Arch Otorhinolaryngol. 2024; 281(7): 3325–31.
4. Han SC, Seong J, Cho S-W, Kim H-J, Kim J-W, Kim D-Y, et al. The search for an ideal definitive treatment of sinonasal squamous cell carcinoma with orbit invasion. Clin Exp Otorhinolaryngol. 2024; 17(3): 253–62.
5. Patil A, Durai P, Shetti P, Desai T, Teli S. Sinonasal squamous cell carcinoma mimicking a brain abscess: Report of a unique case. Cureus. 2024; 16(9): e68687.
6. Zhou A, Sharma A, Kuhnell D, Hinrichs BH, Kendler A, Wang J, et al. Multimodal assessment of high-risk human papillomavirus in sinonasal squamous cell carcinoma. Pathol Res Pract. 2024; 261(155486): 155486.
7. Lian M, Han B, Chen J, Shen X, Zhao Y, Shi Q, et al. Investigating the impact of clinical and genetic factors on the post-surgery prognosis of sinonasal squamous cell carcinoma. Sci Rep. 2024; 14(1): 22167.
8. Contrera KJ, Ferrarotto R, Gunn B, Su SY, Kies MS, Glisson BS, et al. Phase II trial of induction chemotherapy for advanced sinonasal squamous cell carcinoma. Clin Cancer Res. 2025; 31(2): 258–65.
9. Henrion M, Costes-Martineau V, Bravo IG, Boulle N, Solassol J, Vendrell J, et al. Oncogenic human papillomaviruses drive one-third of sinonasal squamous cell carcinoma and are not mutually exclusive for gene mutations. Head Neck. 2025.
10. Kaki PC, Patel AM, Maxwell R, Brant JA, Brody RM, Adappa ND, et al. Choice of adjuvant radiotherapy facility in sinonasal squamous cell carcinoma. Laryngoscope. 2025; 135(2): 705–15.
11. Wu C, Qi Z, Chen J, Yan X, Li S, Wang L, et al. Prognostic value of inflammation and nutritional indicators for sinonasal squamous cell carcinoma: a single-center retrospective study. Laryngoscope Investig Otolaryngol. 2025; 10(1): e70046.
12. Vasudevan SS, Latour M, Yim M. Impact of orbital preservation versus orbital exenteration in advanced sinonasal squamous cell carcinoma—systematic review and meta-

analysis. J Neurol Surg B Skull Base. 2025; 86(S 01): S1–576.
13. Filip P, Losenegger TA, Akers R, Souza GD, Scott J, Khalife S, et al. Identifying genes that could determine prognostication in sinonasal squamous cell carcinoma. J Neurol Surg B Skull Base. 2025; 86(S 01): S1–576.
14. van de Velde LJ, Scheurleer WFJ, Braunius WW, Speksnijder CM, de Ridder M, Devriese LA, et al. Sinonasal squamous cell carcinoma in the Netherlands: a population-based study of 568 cases diagnosed in 2008-2021. Head Neck. 2025; 47(2): 695–705.
15. Hart SA, Hang J-F, Chernock RD, Mikula MW, Rooper L, Amin SE, et al. DEK: AFF2 fusion sinonasal and skull base nonkeratinizing squamous cell carcinoma: a clinical outcome study compared with conventional sinonasal squamous cell carcinoma. Am J Surg Pathol. 2025; 49(2): 130–7.
16. Goh RS, Keng CGH. A meta-analysis on the impact of induction chemotherapy on survival outcomes for sinonasal squamous cell carcinoma. J Rhinol. 2025; 32(1): 10–6.
17. Querney J, Mendez A, Skinner J, Wihlidal J, Ramazani F, Biron V, et al. Prognostic role of p16 overexpression in sinonasal squamous cell carcinoma: a retrospective analysis of Alberta patients. World J Otorhinolaryngol Head Neck Surg. 2025; 11(1): 52–6.
18. Patel SD, Thapar IK, Workman AD, Lopez DF, Bitner BF, Bukzin HB, et al. Comparison of surveillance modalities in the surveillance of sinonasal squamous cell carcinoma recurrence: a multi-institutional study. Int Forum Allergy Rhinol. 2025; 15(4): 384–94.
19. Ara R, Chakraborty RK, Rima SZ, Nahar N, Dowel FA, Khan MN, et al. Unusual bone metastases in Sinonasal squamous cell carcinoma on SPECT-CT bone scintigraphy: Report of a rare case. Bangladesh J Nucl Med. 2025; 27(2): 276–8.
20. Drossaert AC, Bittermann GKP, Kessler PAWH. Sinonasal primary squamous cell carcinoma: a case report to illustrate key diagnostic and therapeutic considerations in managing sinonasal squamous cell carcinoma. Oral Oncol Rep. 2025; 14(100736): 100736.