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Tumors of Sinonasal Tract and Anterior Skull Base and Their Management: Systematic Review

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Abstract: **Tumors including the anterior skull base and paranasal sinuses are challenging to treat because of their relative rarity, the wide variety of tumor types represented, and the irregularity in the degree of involved local structures. We aimed by this Systematic review study to evaluate the treatment approaches of Tumors of sinonasal tract and anterior skull base, though we also intended to discuss the diagnostic procedures because management can't be approached un least the diagnosis is accurate, which is mostly imaging modalities used in the diagnosis of such tumors locations. A literature search for ASB and sinonasal & anterior skull base tumors was performed in January of 2016 through the MEDLINE/PubMed, Embase Databases. It is reported in the literature that substantial deadly sinonasal & ASB tumors can be handled successfully with an en bloc resection through an anterior transfacial-cranial technique. The cranioendoscopic method allows en bloc resection and appreciates these oncologic principles. With this strategy, all facial incisions are avoided and osteotomies are reduced. Although open surgical resection remains the gold standard for the removal of anterior skull base sores, recent information indicates that endonasal endoscopic surgical treatment is safe.**

Keywords: **Tumors, Systematic review, treatment, diagnosis, sinonasal, cranioendoscopic method, transfacial-cranial technique.**

1. INTRODUCTION

Tumors including the anterior skull base and paranasal sinuses are challenging to treat because of their relative rarity, the wide variety of tumor types represented, and the irregularity in the degree of involved local structures [(1)].

The path of spread of these tumors is determined by the complex anatomy of the craniomaxillofacial compartments. These tumors may attack laterally into the orbit and middle fossa, inferiorly into the maxillary antrum and taste buds, posteriorly into the nasopharynx and pterygopalatine fossa (PPF), and superiorly into the cavernous sinus and brain. Surgical treatment stays the crucial technique of treatment of anterior skull base tumors. Integrated craniofacial techniques for the resection of tumors of the anterior skull base were first explained by Ketcham et al. [(2)] in 1963. Ever since, anterior skull base surgical treatment has evolved greatly, with a much better understanding of the anatomy, pathology, imaging and surgical techniques. The craniofacial technique and the sub-cranial approach have actually ended up being the requirement of look after the treatment of deadly tumors involving the anterior skull base [(3,4)] and, because of this and the varied histologic findings, the majority of outcomes data show the experience of small patient associates [(5)].

Over the past twenty years, advances in endonasal endoscopic surgical treatment in terms of both experience and innovation have actually expanded its efficacy in the management of deadly sinonasal tumors [(6)]. While an external method stays the gold requirement for resection of these tumors, unfavorable morbidity can consist of facial cut and

scarring, the need for craniotomy or facial bone osteotomy, surgical problems, longer hospitalization period and slower healing. When applicable, brain retraction with associated encephalomalacia and edema can likewise be avoided [7,8]. Standard external techniques look for to achieve an en bloc resection of all included bone and soft tissue with unfavorable histopathological margins, most typically by means of the techniques of lateral rhinotomy or midface degloving [9]. Ought to the cribriform plate or fovea ethmoidalis be included by the exceptional level of the tumor, anterior craniofacial resection is generally needed [10]. The goal in any technique is to adequately expose the nasal cavity, while maintaining function and cosmetic for the patient [9,10].

We aimed by this Systematic review study to evaluate the treatment approaches of Tumors of sinonasal tract and anterior skull base, though we also intended to discuss the diagnostic procedures because management can't be approached un least the diagnosis is accurate, which is mostly imaging modalities used in the diagnosis of such tumors locations.

2. METHODOLOGY

Study design:

A systematic review of the published literature on cases of tumors of sinonasal and anterior base of the skull.

Search strategy:

A literature search for ASB and sinonasal & anterior skull base tumors was performed in January of 2016 through the MEDLINE/PubMed, Embase Databases. A multifield search was performed using the following search terms: "anterior skull base" OR "sinonasal" OR OR "subfrontal" OR "sinonasal" OR "frontal lobe" OR "intracerebral" OR "intracranial" OR "cranionasal" OR "paranasal sinus" AND "tumor" OR "cancer". We searched with this method to be able to identified relevant articles pertaining to ASB and sinonasal tumors management, The bibliographies of each these studies were searched for more relevant articles. All articles in the peer-reviewed English literature that reported human subjects were included. of these articles were also used as a supplemental data source.

3. RESULTS

- ***Diagnostic procedures:***

The primary role of imaging in the setting of sinonasal malignancy is to recognize deadly disease, its anatomical level and any metastatic lymphadenopathy. Radiological findings suggestive of malignancy include bony involvement (disintegration and damage), a soft tissue part, a unilateral disease procedure and soft tissue necrosis with or without lymphadenopathy [11]. The clinician ought to know factors which are associated with particularly poor patient prognosis, such as tumour encasement of the carotid artery, extension to include the periorbita or dura, spacious sinus invasion and perineural tumour spread. Metastatic lymphadenopathy is suggested by the presence of nodal clustering, rounded shape, inhomogeneity on contrast-enhanced research studies and peripheral spread, all in the context of a possible drainage path [12]. When appropriate, these factors are essential factors in the preparation of endoscopic surgery and possible postoperative radiation.

When tumors occur in the maxillary or ethmoid sinuses, the American Joint Commission on Cancer T-category is applied to imaging findings [13]. Computed tomography (CT) represents the very best modality with which to assess for the existence of bony renovation or bony invasion, for example of the sinus walls, orbital margins and the floor of the anterior cranial fossa (**Figure 1**) [16]. Coronal and axial views are essential for total evaluation of the pterygoid plates, maxillary sinus, ethmoid bullae and sinus and sphenoethmoid recess. Magnetic resonance imaging (MRI) is a crucial tool for the assessment of bone marrow invasion, where the high T1 signal fatty marrow is changed by that of tumor [11,14]. Displacement of the periorbita is usually detected on CT, with a reported NPV of 86% and PPV of 75% [15]. The vital orbital finding is intrusion beyond the periorbita (i.e. fat, muscle) as periorbital intrusion can be approached endoscopically, but participation of the fat or muscle will generally necessitate orbital exenteration (**Figure 2**) [16]. MRI is also important in the evaluation of dural involvement and brain intrusion. The former is evidenced by focal thickening and enhancement of the dura. Brain invasion is recommended by the existence of both brain edema and parenchymal enhancement and cortical interruption (**Figure 2**) [16].

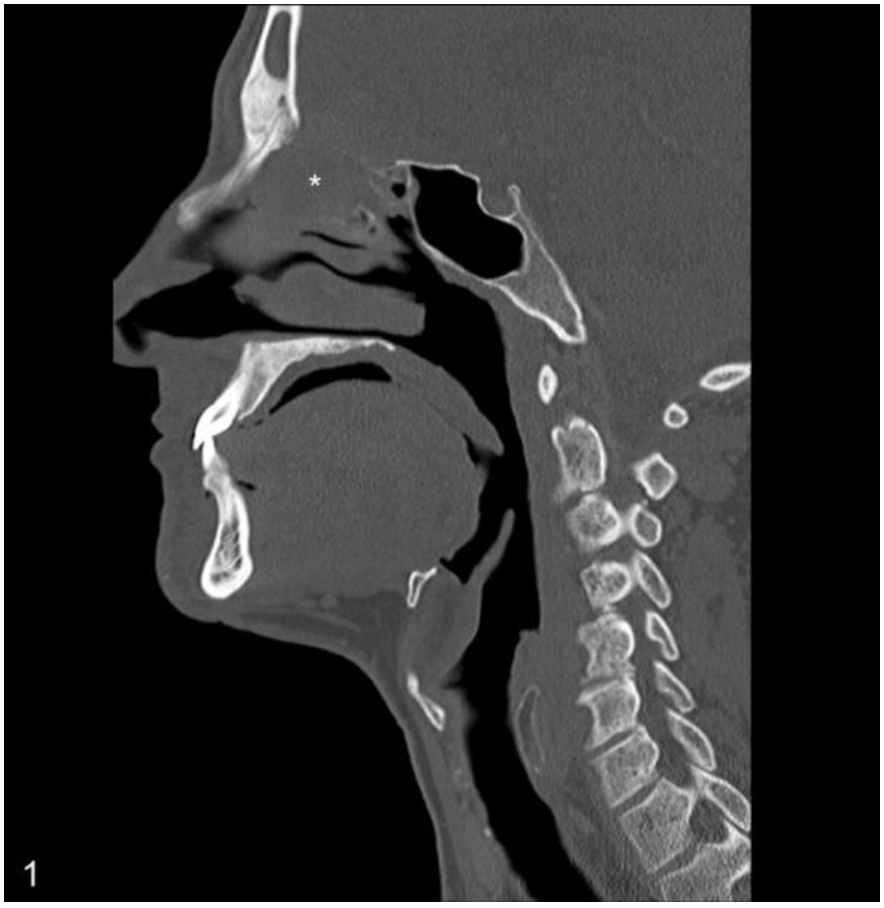

Figure 1: Sagittal CT bone algorithm image of a squamous cell carcinoma in the ethmoid sinus (asterisk) that has eroded the overlying floor of the anterior cranial fossa. [16]

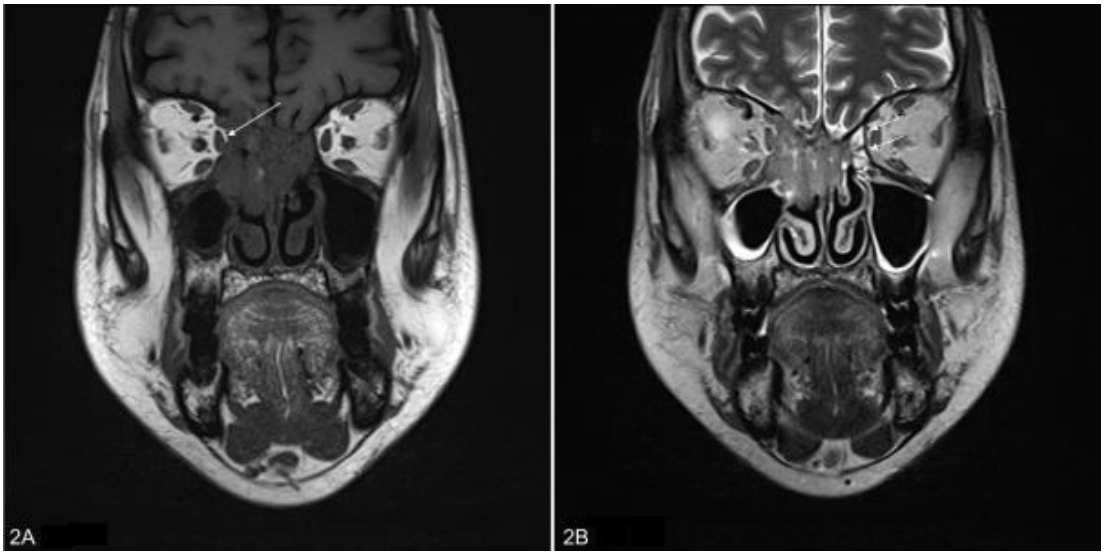

Figure 2: Coronal T1- (a) and T2 (b)-weighted images show an ethmoid sinus carcinoma that has disrupted the periorbita along the right medial orbital wall. Note the normal appearance of the periorbita on the left side which appears as a smooth curvilinear black line (white arrows in (b)). On the affected side, the black outline is attenuated and more irregular in contour. However, (a) still shows preservation of the orbital fat (arrow in (a)) and the rectus musculature. [16]

Simply endonasal resections within the frontal sinus are likewise restricted by the sore laterality. Using the modified Lothrop treatment, the flooring of the frontal sinus can be removed to method tumors. This is generally restricted to those tumors which have actually extended into the sinus with minimal or no bony involvement. Tumor inhabiting the frontal sinus is typically heterogeneously boosting on a gadolinium T1 sequence. Vascular encasement and nerve participation,

finest identified with MRI, are likewise contraindications to pure endoscopic resection, but a combined external and endoscopic approach might assist in circumferential dissection around these structures [14,17]. Last, MRI has been revealed to have a 100% sensitivity and 94% uniqueness in the identification of jugular vein and venous sinus invasion [18].

- ***Anatomy of anterior base skull:***

The anterior skull base is an intricate anatomical compartment. It can be specified as the portion of the skull base adjacent to the anterior cranial fossa. The anterior skull base limits include the medial border that is formed by the cribriform plate, comprising the roofing of the nasal cavity, the lateral border that is formed by the orbital plates of the frontal bone that form the roofing system of the orbits and ethmoid air cells, and the posterior border that is formed by the planum sphenoidale and lower wings of the sphenoid [4]. The cribiform plate is traversed by numerous olfactory nerves that extend from the olfactory mucosa to the olfactory bulbs. A bony fissure in between the lesser and greater sphenoid wings, the exceptional orbital fissure, gives passage to cranial nerves III, IV, V and VI and to the exceptional ophthalmic vein. Superior and laterally lies the optic canal bordered by the body of the sphenoid and by the inferior and exceptional roots of the lower sphenoid wing, offering passage to the optic nerve, ophthalmic artery, and understanding nerves. Both the superior orbital fissure and optic canal open in the middle cranial fossa and are most typically impacted by main skull base lesions [4]. The thin cribiform plate is quickly crossed by tumors; however, the orbital plates of the frontal bone are made of a thick compact bone that makes up a barrier to tumor growth into the anterior cranial fossa. For that reason, it is not surprising that many tumors affecting the anterior skull base occur from the sinonasal area.

- ***Management approaches of Anterior skull base (ASB) tumors:***

Surgical Midfacial Degloving (MFD) for ASB treatment:

The MFD method combines the sublabial incision used in external approaches to sinus surgical treatment with the intranasal cut utilized in cosmetic rhinological surgery. The primary benefit of this approach over conventional lateral rhinotomy or Weber-Ferguson approaches is avoidance of facial cut. This technique was initially designed for benign tumours, consisting of inverted papilloma, juvenile angiofibroma, odontogenic cysts, and benign fibro-osseous lesions [19]. Nowadays, MFD has actually been mainly replaced by the endonasal method as the main strategy for extirpation of these sores. It can be used for big tumours involving the anterior skull base, in conjunction with an 'upper' method, or after the failure of an endonasal resection. The MFD technique includes a total transfixation incision, with a complete intercartilaginous cut. This effectively separates the upper lateral cartilage from the lower lateral cartilage, the latter which is later on included with the superiorly pulled back flap. Next, a 'degloving' of the facial soft tissue from the nasal skeleton and maxilla is performed. This is accomplished through a sublabial incision that extends from first molar to first molar. We have actually popularised the use of MFD in conjunction with the subcranial method in order to bring back the skull base tumour excision in its posterior and inferior-lateral extension [20] (**Figure 3**) revealing the transfacial techniques [21].

Figure 3: Facial incisions for the resection of craniofacial neoplasms: lateral rhinotomy, Weber-Ferguson, and midciliary. Combined approaches are possible [21]

The Subcranial Approach:

The subcranial technique is a single-stage procedure utilized for tumours involving the anterior skull base [22,23]. The extent of direct exposure with the subcranial approach consists of the frontal sinus anteriorly, the clivus posteriorly, the frontal lobe superiorly and the paranasal sinuses inferiorly. Laterally, the boundaries of this technique are both exceptional orbital walls. The subcranial approach has numerous significant benefits: (i) it manages direct exposure of the anterior skull base from anterior to posterior instead of from above and listed below, as in the craniofacial technique; (ii) it permits simultaneous intradural and extradural tumour elimination from anterior to posterior; (iii) it does not require facial incision; and (iv) minimal frontal lobe adjustment is required. The subcranial approach involves a coronal incision and osteotomy of the naso-fronto-orbital bone segment, which allows access to the intra- and extra-cranial compartments of the anterior skull base (Figures 4) [21]. The main drawback of this technique is bone osteonecrosis post radiotherapy in cases of malignant tumours [24].

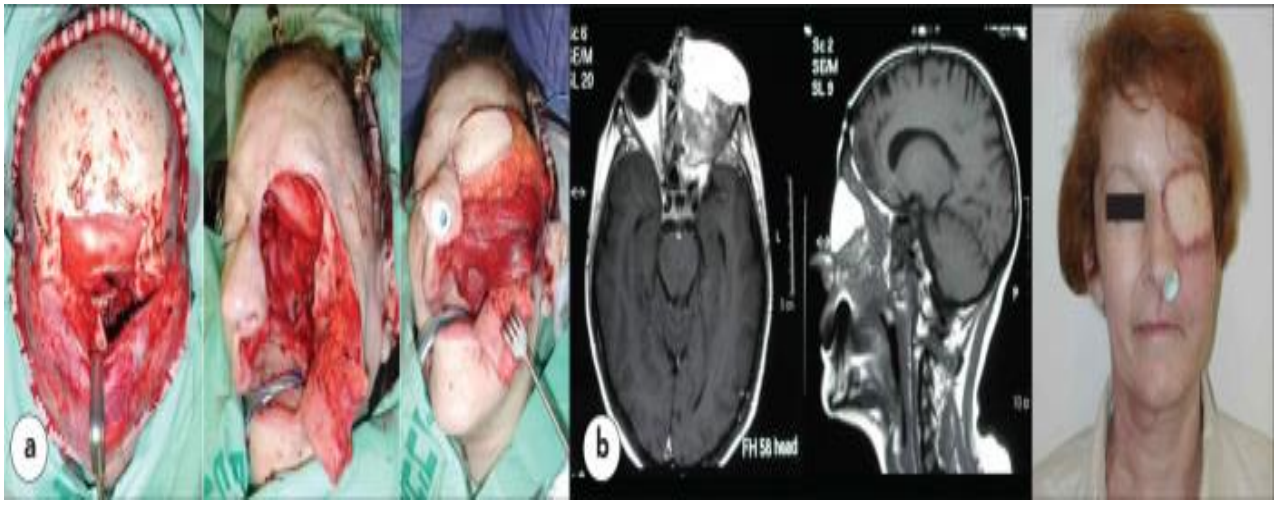

Figure 4: a) Intraoperative view for the subcranial-transorbital combined approach. b) The subcranial-transorbital combined approach. Postoperative CT scans (middle and left) and general appearance (right) are shown [21]

Sinonasal carcinoma:

One carbon-ion study [25] 2 proton studies [26,27] and 2 intensity modulated radiotherapy (IMRT) research studies [28,29] reported results for paranasal or sinonasal carcinoma. The pooled estimates of 5-year LC were 49% for carbon-ion treatment, 88% for proton treatment and 66% for IMRT. Distinctions in 5-year LC in between proton therapy and IMRT were statistically substantial (P-value 0.035). Five-year DFS was 61% for protons and 54% for IMRT, while 5-year OS was 71% and 52% respectively. Both DFS and OS were not statistically substantially various (P-values 0.682 and 0.323). It was not possible to consist of the percentage of patient with T4, phase or n3 IV tumors as covariates in the meta-analyses since none of the included studies reported the variety of stage IV tumors and the variety of T4 tumors or N3 tumors were only reported in the two photon studies (Appendix 4). None of the other covariates (including the percentage of operated patients) had a statistically substantial impact on the result. One proton research study reported that no late visual toxicity of RTOG grade 3 or higher was observed [26]. However, another research study considering visual results after combined photon/proton treatment reported LENT/CTC v2.0 visual toxicity of grades 1, 2 and 3 of respectively 14%, 17% and 6%.75 For IMRT, one study reported CTC v2.0 grade 3 visual toxicity in 9% of the patients, which 4 patients (6%) had pre-treatment visual impairment [29].

Treatment outcomes:

Morbidity can't worry about both craniofacial-only and combined craniofacial/endoscopic resection, including but not limited to meningitis, encephalomalacia/oedema, pneumocephalus, loss of sight, trismus and bone flap necrosis [30,31,32]. However, the most common severe issue is CSF leakage, and modern advances in endoscopy have actually yielded rates similar with open resection. With the introduction of the vascularised nasoseptal flap, CSF leak rates have dramatically fallen in many centres. A research study of 800 endonasally dealt with patients exposed a CSF leakage rate of 15.9%, in which all but one case was treated effectively with repeat endonasal endoscopy or lumbar drainage [33]. These data are favourable for endoscopic over external resection, though most of the tumours in the research study were benign. A large

series of malignant sinonasal tumors treated with pure endoscopic (72.8%) or cranioendoscopic (27.2%) strategies including 184 patients revealed a 5-year disease-specific survival of 91.4% and 58.8% respectively. The authors concluded that while operator experience is a substantial factor, endoscopic management of malignancies eligible for either external or endoscopic resection is a similarly efficacious option to an external approach1. The largest US study to date dealing with pure endoscopic (77.5%) and cranioendoscopic (22.5%) resection of malignant tumors substantiated the assertion that oncological outcomes are acceptable with these techniques [(31)]. In their study of 120 patients, where the most typical site of tumor origin was the nasal cavity (52%), favorable margins were present in 15% of patients and the 5- and 10-year disease-specific survival rates were 87% and 80%, respectively. Recurrence rates did not vary in between the two groups. Encouragingly, CSF leakage happened in 3% of patients and was also not considerably various in between the groups. It is notable that in both studies, the percentage of olfactory neuroblastoma was high, as these are typically connected with excellent prognosis for 5 - 10 years prior to possible reoccurrence. In addition, the percentages of patients in either treatment group were not always matched for disease stage [(31)].

Last, there is excellent theoretical advantage for senior patients going through resection of sinonasal malignancies. Outcome of craniofacial resection in patients 70 years of age and older are considerably even worse in terms of mortality, problem and disease-specific long-lasting survival [(34)]. Considered that senior patients frequently do not tolerate brain retraction well; pure endoscopic resection stands to improve outcomes in this population.

4. CONCLUSION

It is reported in the literature that substantial deadly sinonasal & ASB tumors can be handled successfully with an en bloc resection through an anterior transfacial-cranial technique. The cranioendoscopic method allows en bloc resection and appreciates these oncologic principles. With this strategy, all facial incisions are avoided and osteotomies are reduced. Although open surgical resection remains the gold standard for the removal of anterior skull base sores, recent information indicates that endonasal endoscopic surgical treatment is safe and is related to acceptable outcomes in patients with early and benign malignant neoplasms. With developments in imaging, diagnostic innovation, diagnostic pathology, surgical technology and instrumentation, reconstructive techniques, and rehab, it is anticipated that endoscopic methods will evolve to round out the personnel armamentarium.

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