PERINEURAL SPREAD IN HEAD AND NECK PATHOLOGIES: A PICTORIAL REVIEW

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ABSTRACT

The perineural space is a potential space between neural elements and the epineural sheath in a nerve. This can serve as a conduit for the spread of malignant, inflammatory and infective head and neck pathologies to a location distant from their source of origin. Imaging techniques, including contrast-enhanced MRI and PET-CT scans play an important role in the identification of this entity. This is a series of three cases of head and neck pathologies with perineural intracranial extension of disease, with emphasis on anatomy and imaging features of nerve involvement.

Introduction

A potential space located between nerve axons, its supporting stroma and the outer epineural fibrous sheath surrounding it is called the perineural space.[1] This space, by a complex interaction between tumor and neural cells influenced by the local micro-environment provides a conduit for the spread of tumors, infective and inflammatory disorders to a distant site from the area of primary involvement, a phenomenon known as perineural tumor spread.[2,3,4,5] Branches of trigeminal and facial nerve serve as the commonest source for this process to occur.[6] Since clinical features of nerve involvement are mostly non-specific, and this phenomenon has therapeutic and staging consequences, the role of imaging is pivotal to determine nerve involvement and establish the extent of disease.[7,8] Here we discuss a series of cases of head and neck pathologies with perineural extension along branches of the fifth cranial nerve.

Case 1

39 year-old male with no known co-morbidities presented to the outpatient ENT clinic with complaints of nasal blockage, ear ache and numbness in the facial region for 2 months.

He was referred to the imaging department for MRI of head and neck with contrast.

This revealed (Fig. 2 A-D), with abnormal FDG uptake in the lesion and along the course of mandibular division of the trigeminal nerve extending up to the cavernous sinus. No other abnormal FDG uptake is seen. No nodal involvement or distant metastasis seen.

Biopsy of the lesion was performed which revealed it to be squamous cell carcinoma.

On the basis of imaging and histopathologic findings, diagnosis was squamous cell carcinoma of the nasopharynx with perineural spread. TNM staging: Stage IVa disease with T4,N0,M0 (9).

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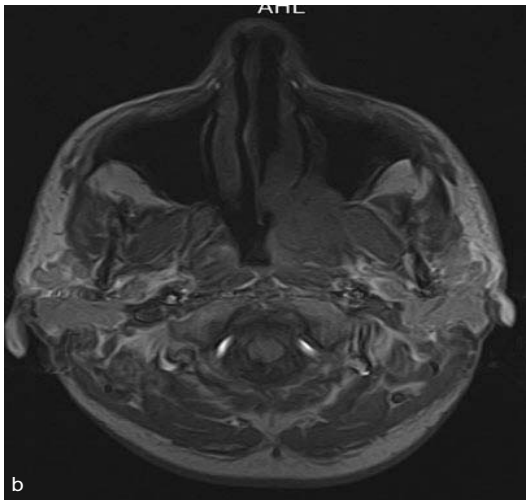
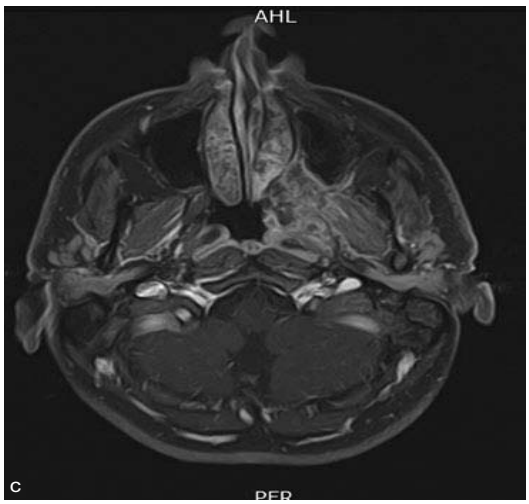
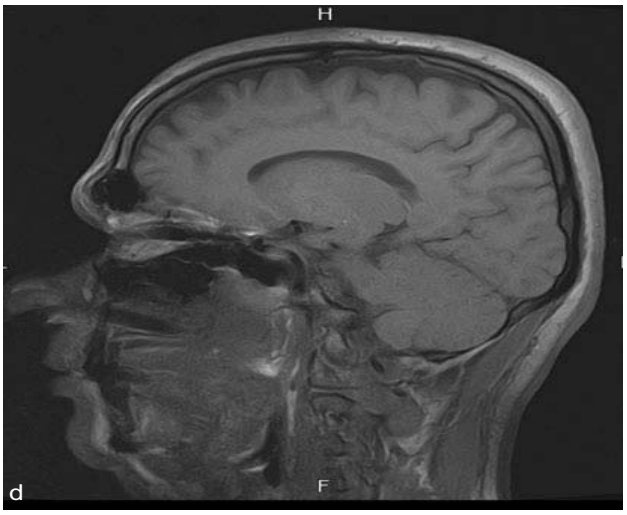




Figures 1a,b,c: Axial T1, T2-weighted and T1 post-contrast images reveal an abnormal signal intensity lesion involving left parapharyngeal soft tissues which appears isointense on T1 and slightly hyper intense on T2-weighted images showing post-contrast enhancement. It is extending into the nasal cavity and left maxillary sinus. The left-sided muscles of mastication appear hyper intense on T2 weighted images



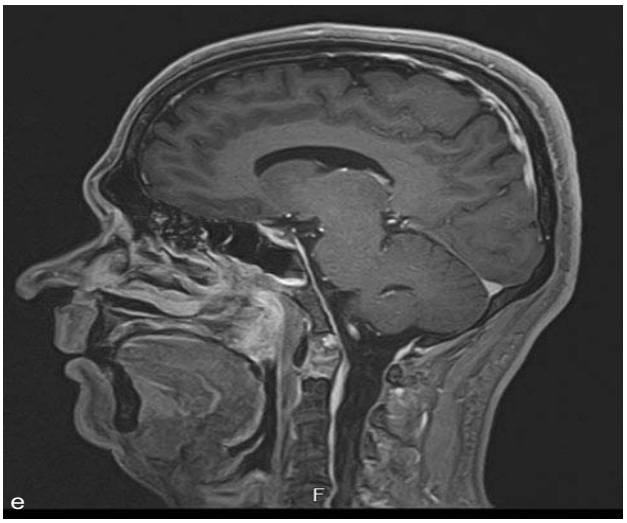
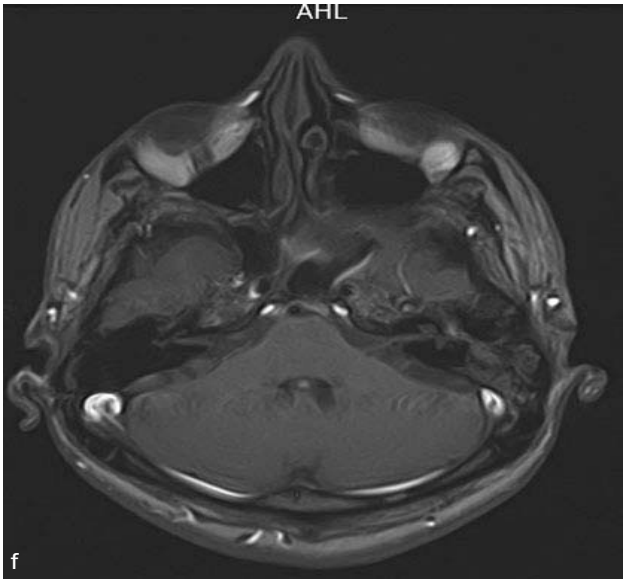


Figure 1d,e: Sagittal T1 and T1 post-contrast images show the lesion is extending inferiorly to involve the hard palate.



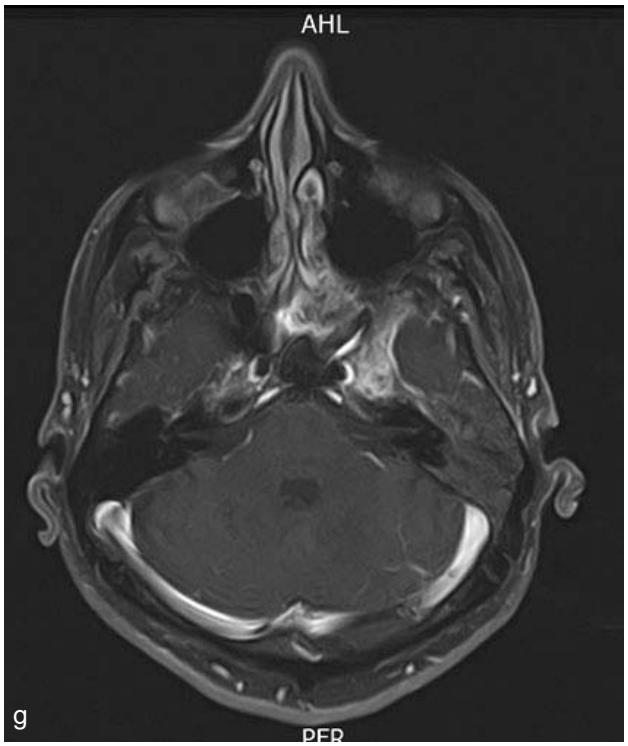


Figure 1f,g: Axial T1 and T1 post-contrast images through base of skull reveal extension of abnormal signal up to the cavernous sinus.

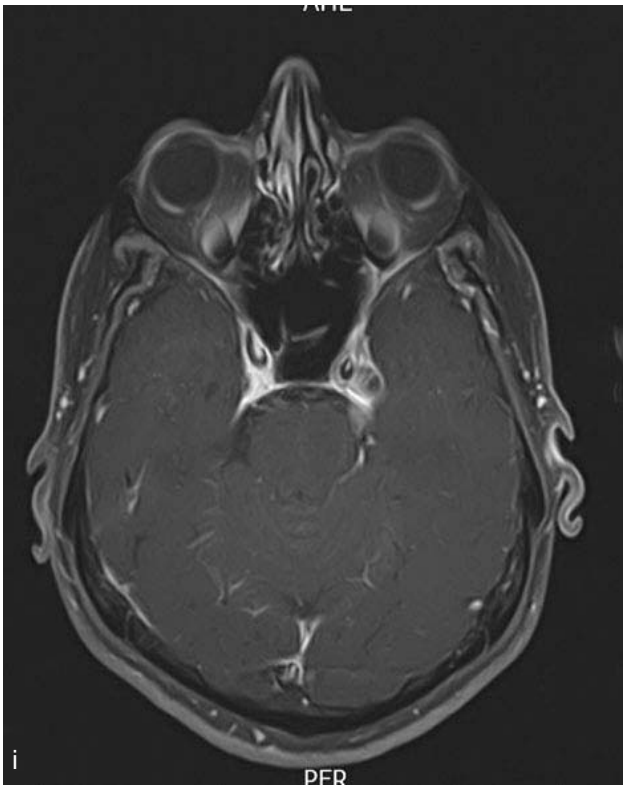
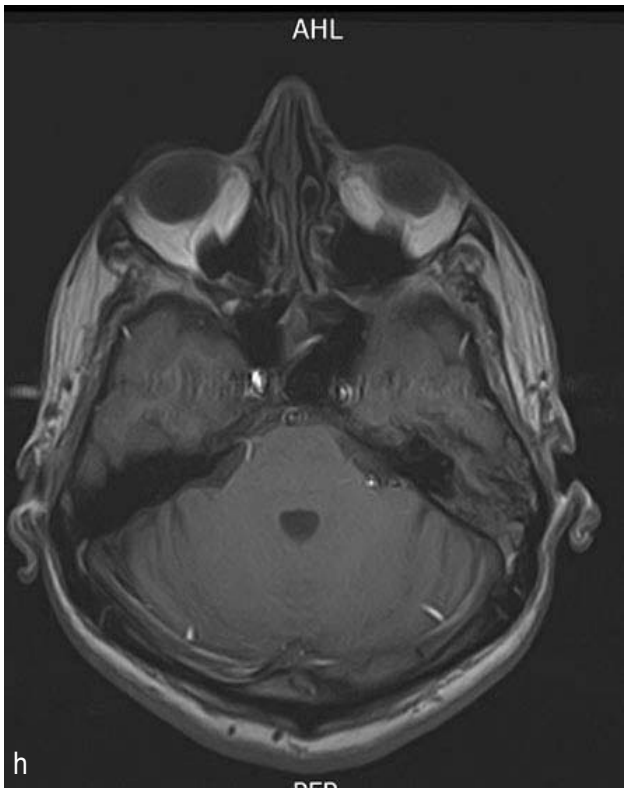
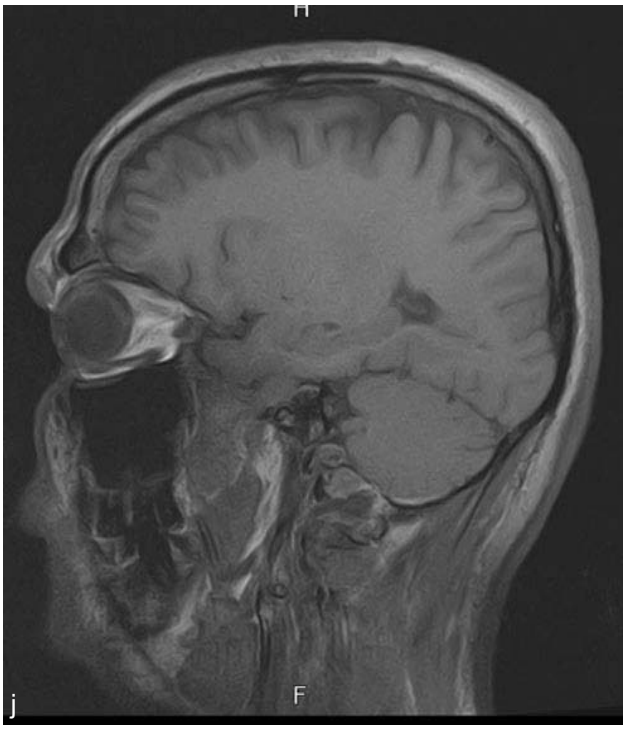


Figure 1h,i: Axial T1 and T1 post-contrast images reveal involvement of the dura with a small intradural extension of enhancement; however, there is no involvement of brain parenchyma.





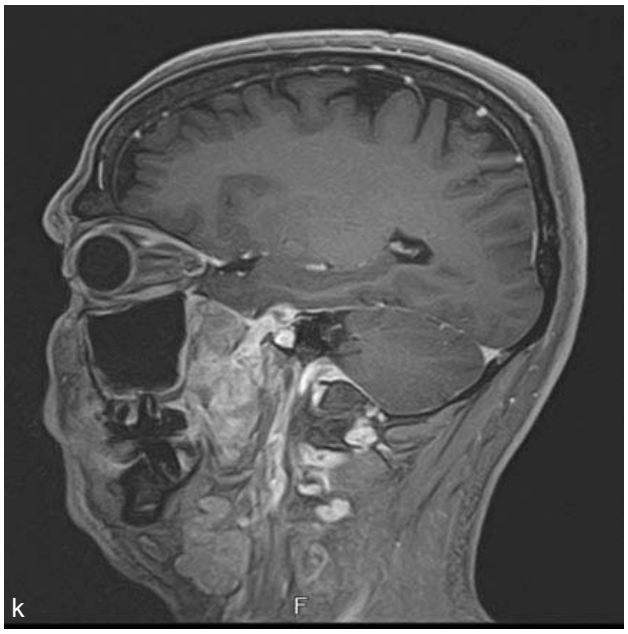
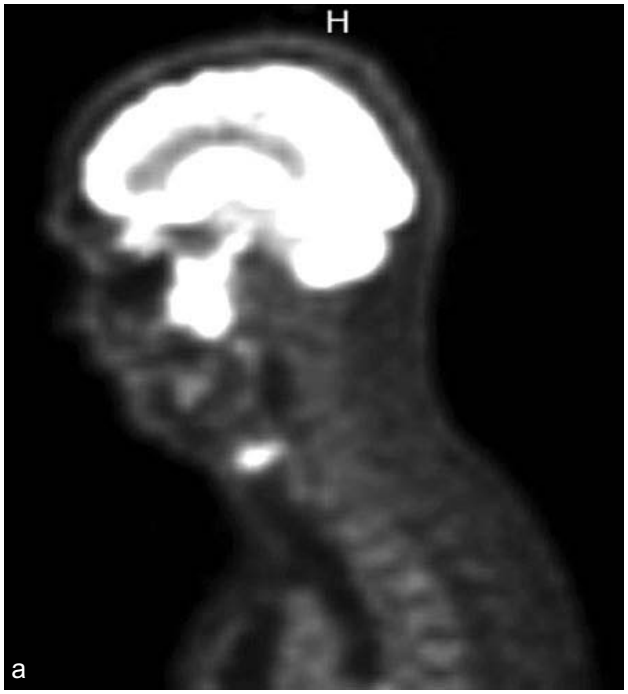
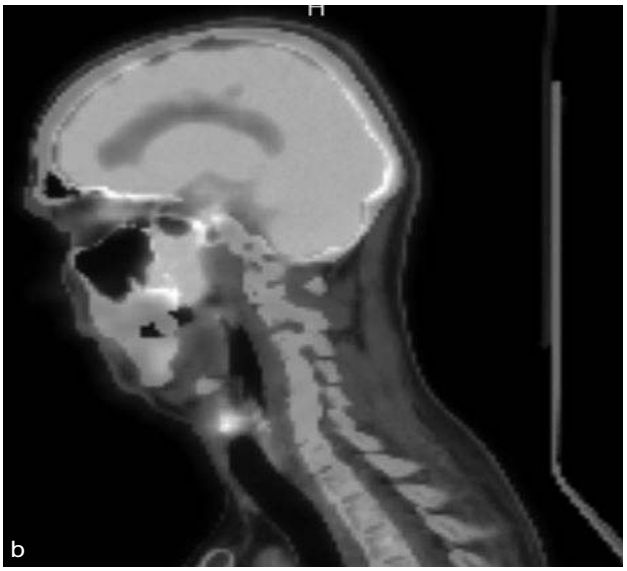
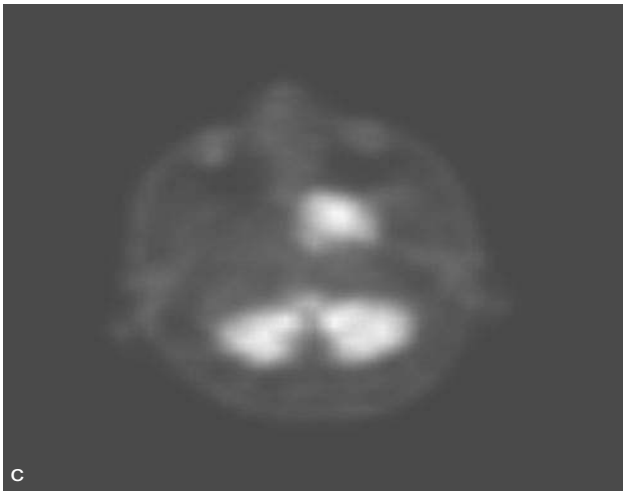


Figure 1j,k: Sagittal T1 and T1 post-contrast images reveal abnormal thickening and enhancement of the mandibular division of the trigeminal nerve with signals extending up to the region of the cavernous sinus.

On the basis of MRI findings this was reported as a neoplastic lesion of nasopharyngeal soft tissues with perineural spread along branches of the fifth cranial nerve with intradural extra-axial extentsion.
A PET-CT scan was requested to stage the disease:-







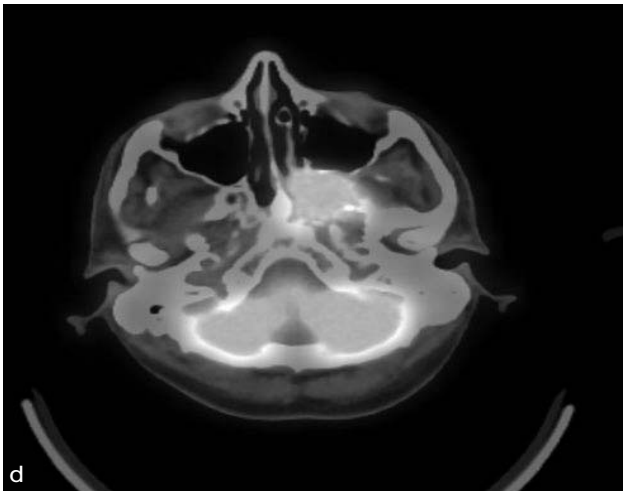


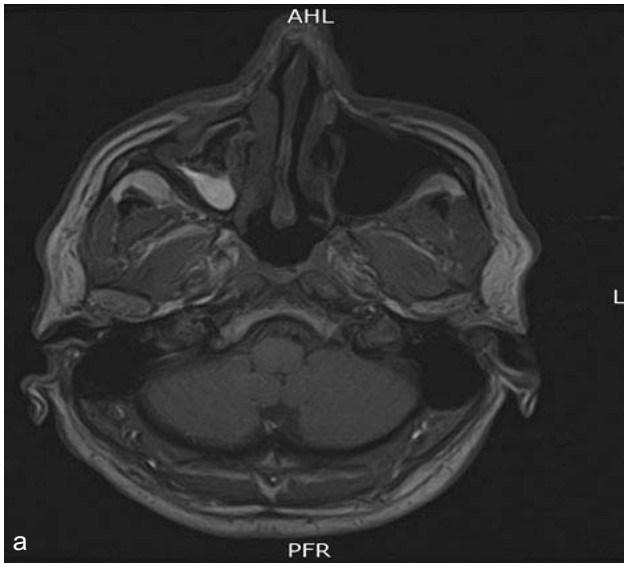
Figure 2a-d: Abnormal FDG uptake in the lesion and along the course of mandibular division of the trigeminal nerve extending up to the cavernous sinus. No other abnormal FDG uptake is seen. No nodal involvement or distant metastasis seen.

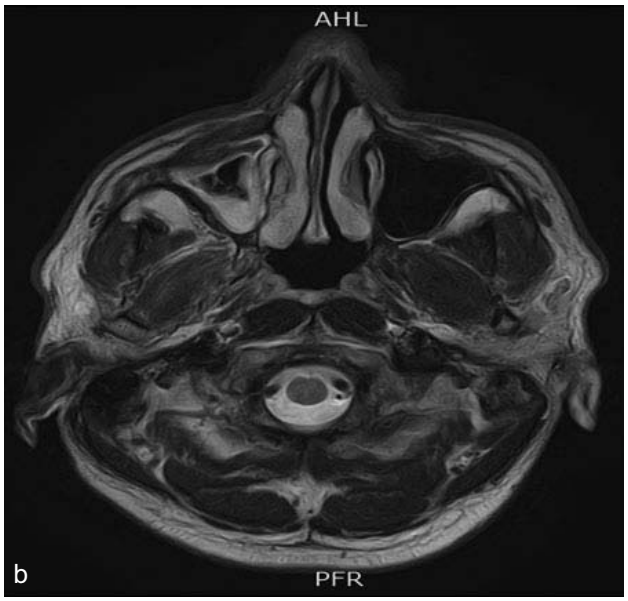
Biopsy of the lesion was performed which revealed it to be squamous cell carcinoma.

On the basis of imaging and histopathologic findings, diagnosis was squamous cell carcinoma of the nasopharynx with perineural spread. TNM staging: Stage IVa disease with T4, N0, M0 (9).

Case 2

44 year-old male with no known co-morbidities presented to the ENT outpatient clinic with history of acute right facial pain since 1 week. Clinical diagnosis was acute sinusitis and patient subsequently underwent unilateral endoscopic functional sinus surgery. Following this, the patient was discharged in a stable condition.





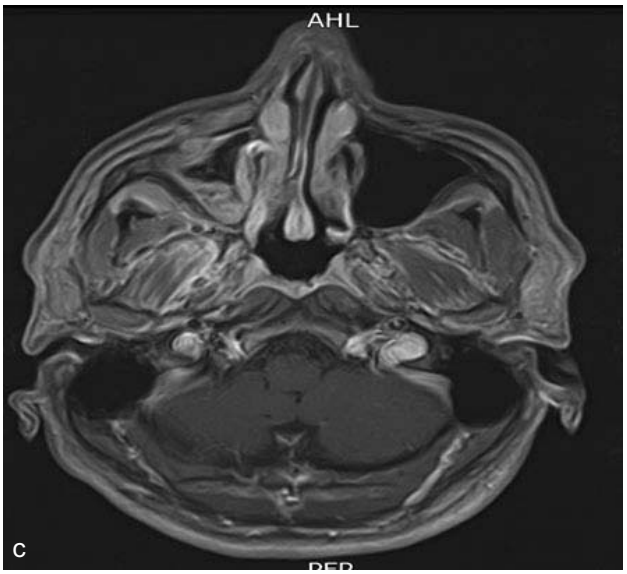
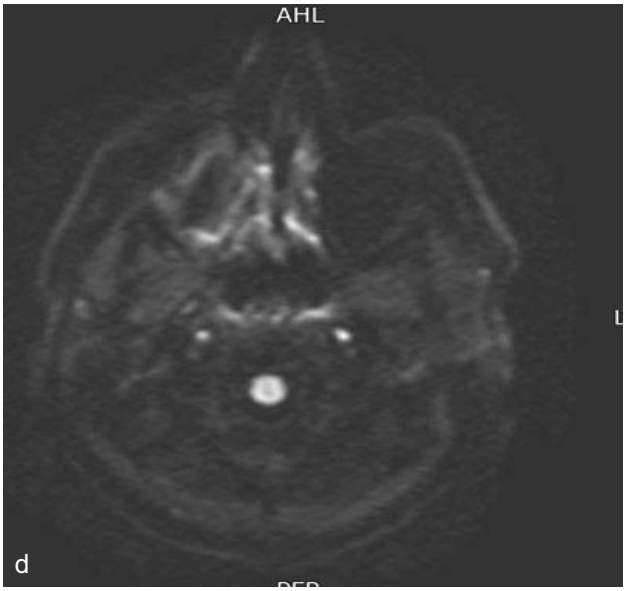


Figure 3a,b,c: Axial T1, T2 and T1 post-contrast images revealed deformed right maxillary sinus, and abnormal signals in soft tissues anterior to right maxillary sinus and adjacent ipsilateral muscles of mastication. The signals were isointense on T1 and hyper intense on T2- weighted images showing patchy post-contrast enhancement. There were T1 and T2 hyper intense signals in the right maxillary sinus.

Following discharge, the patient subsequently developed numbness in domains of maxillary and mandibular divisions of the trigeminal nerve. He was referred to the radiology department for a contrast-enhanced MRI brain.



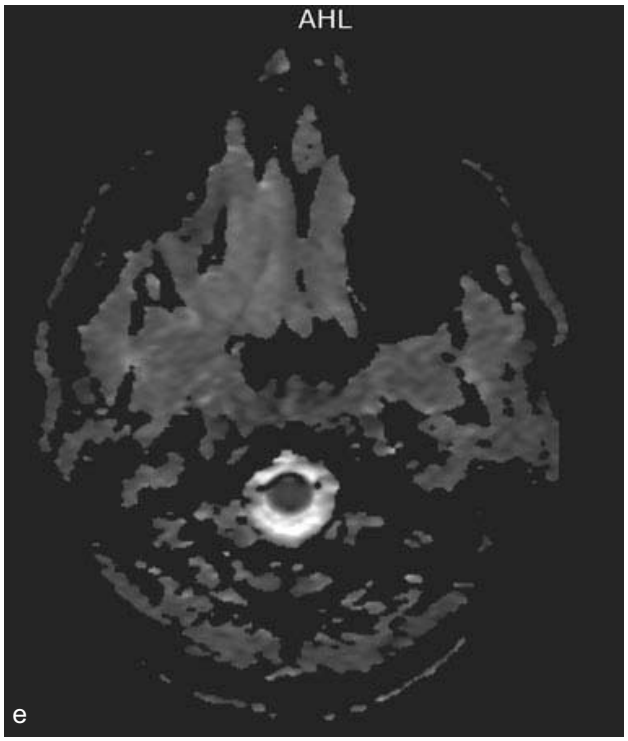
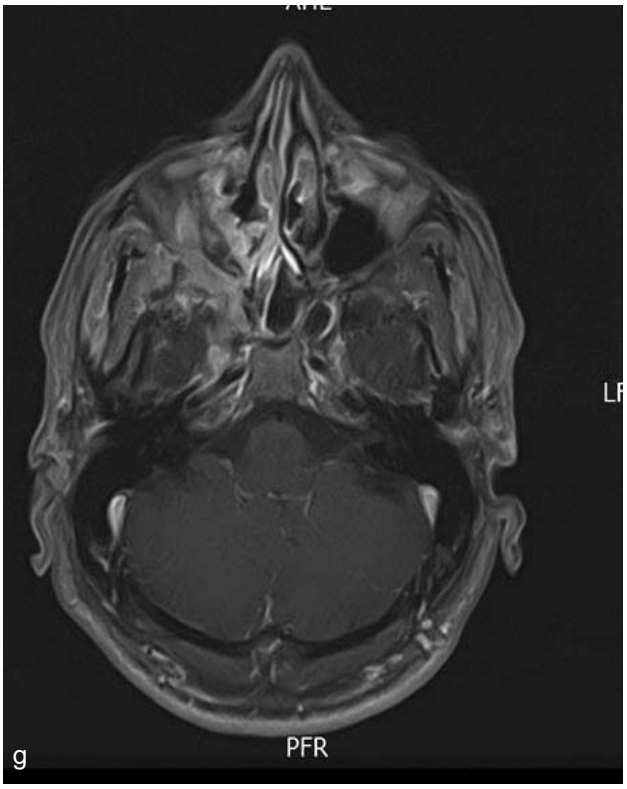
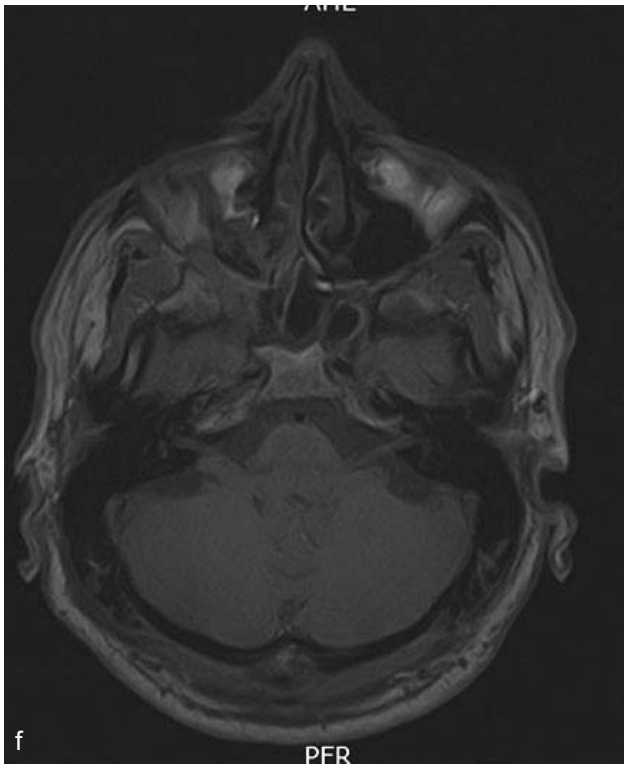
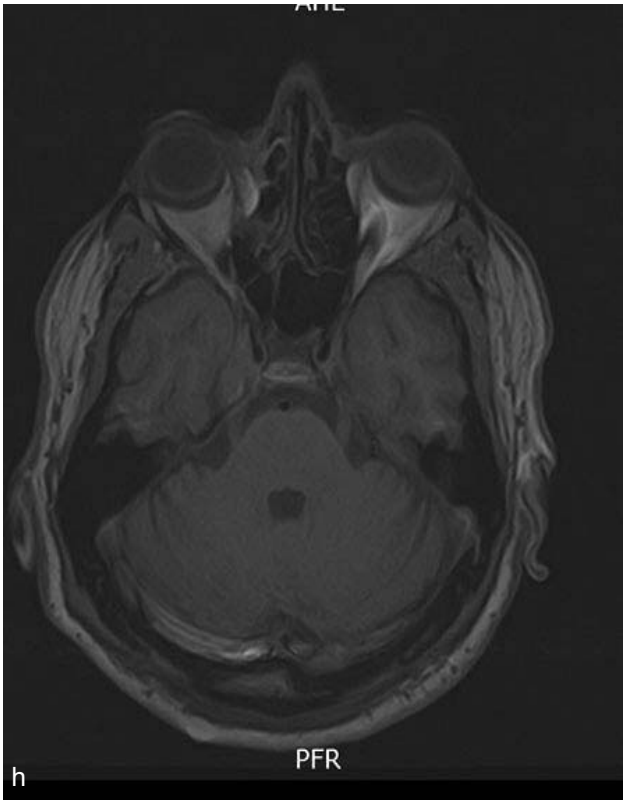


Figure 3d,e: Axial DWI and ADC images revealed diffusion restriction in the corresponding abnormal signal.







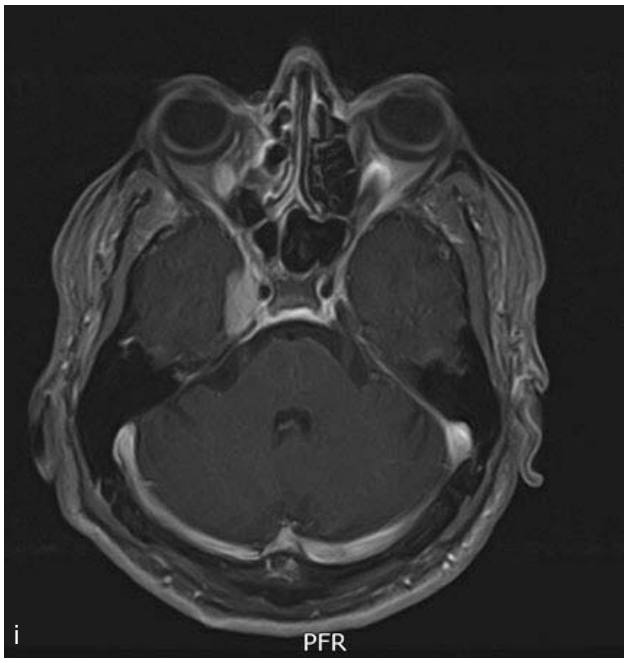
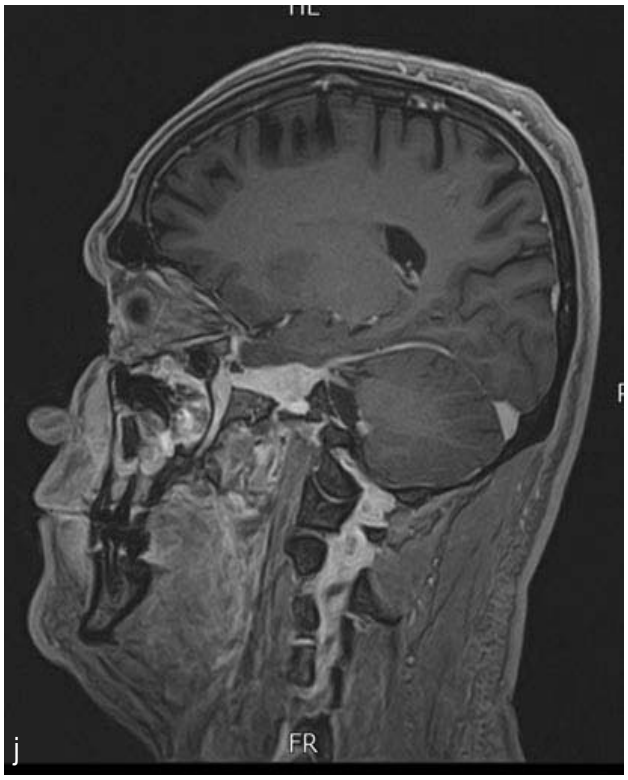


Figure 3f-i: Axial T1 and T1 post-contrast images reveal extension of abnormal signal and enhancement in the pterygopalatine fossa with abnormal signal intensity enhancing lesion lying in Meckel s cave.



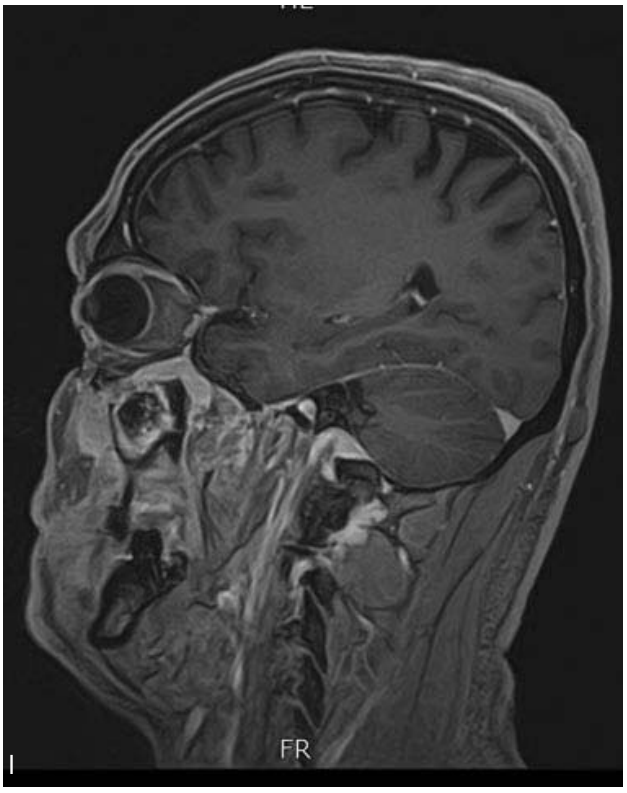


Figure 3j-l: Sagittal T1 and T1 post-contrast images reveal abnormal signal in right maxillary sinus with thickening and enhancement of maxillary and mandibular division of trigeminal nerve with extension of the abnormal enhancement up to Meckel s cave.

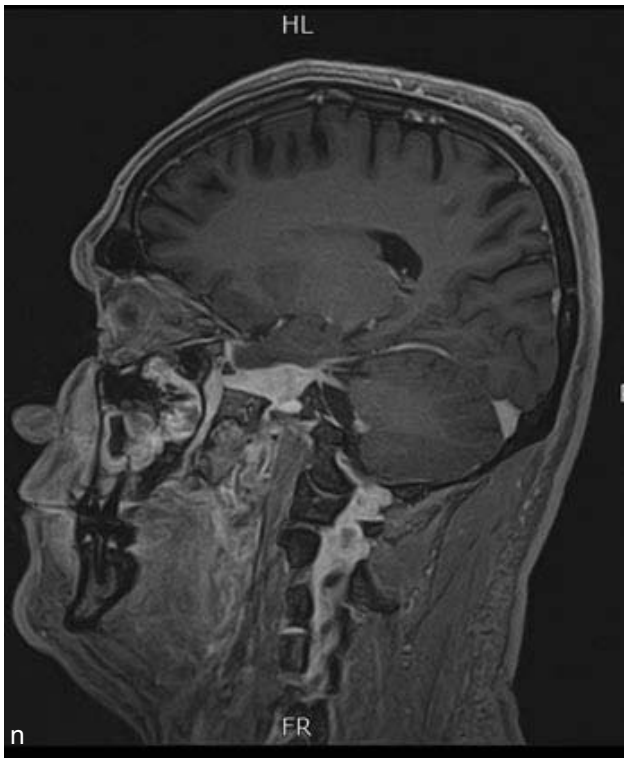
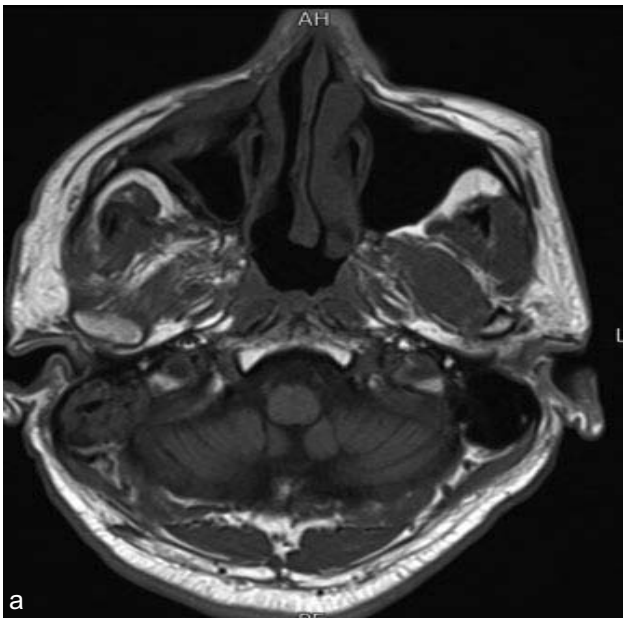


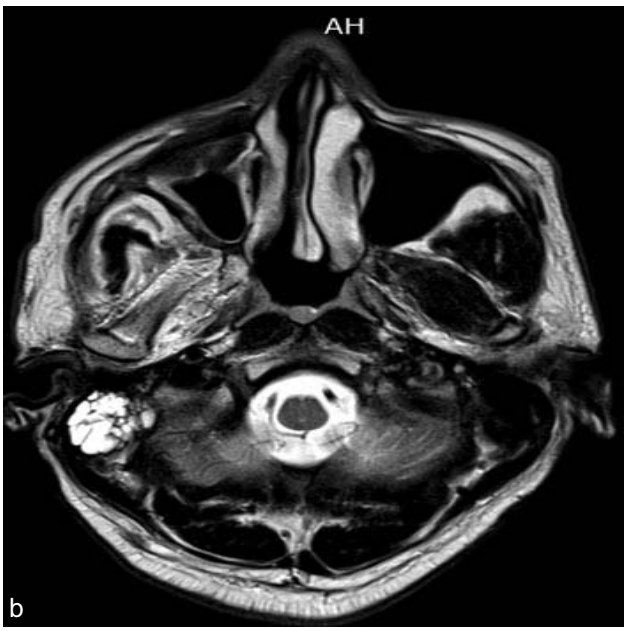
Figure 3m,n: T1 post-contrast sagittal images are a comparison of left and right Meckel s cave. On comparison, an abnormal lesion with enhancement in right Meckel s cave can be clearly appreciated.

On the basis of above mentioned findings, two possible conclusions were reached. The first possibility was a trigeminal schwannoma with changes in right maxillary region being post-surgical with the other possibility being sinus fungal infection with perineural spread.

Patient subsequently underwent supra-tentorial biopsy. Operative notes revealed tough ependymal tissue and high pressure CSF.

Immediately following surgery, repeat MRI brain with contrast was performed which revealed:-





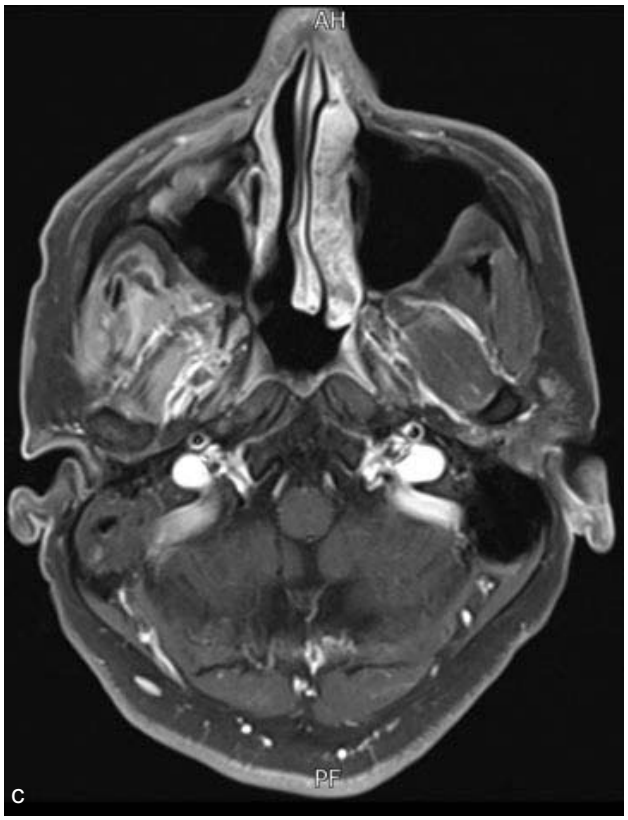
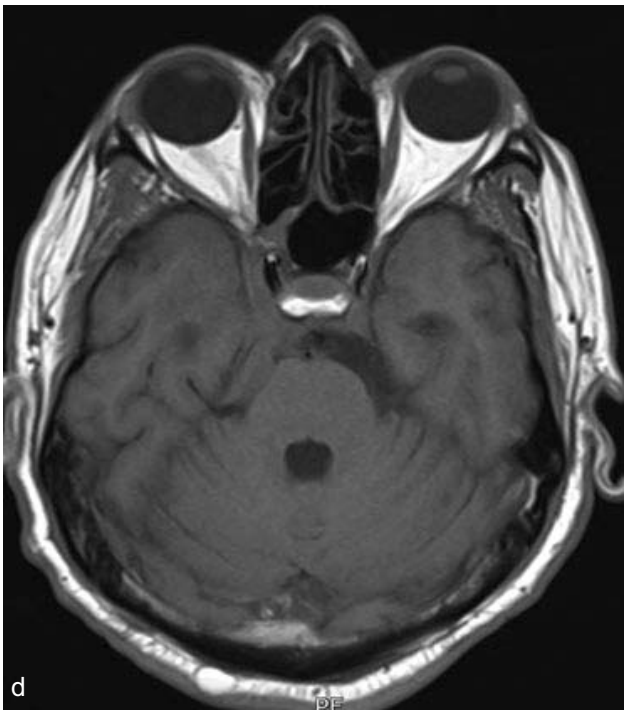


Figure 4a-c: T1, T2 and T2 post-contrast axial images showing interval increase in enhancement in right maxillary region. There is interval development of fluid signals in right mastoid air cells representing mastoiditis.



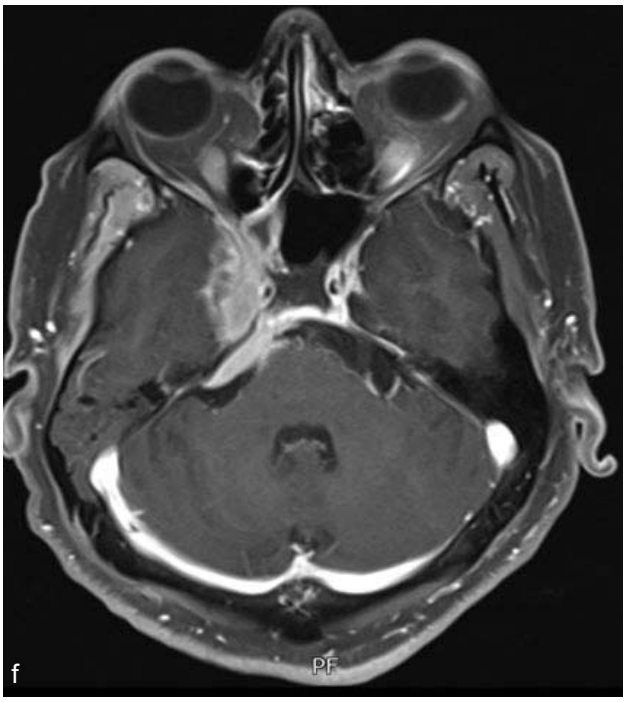


Figure 4d-f: Axial T1, T2 and T1 post-contrast images reveal extension of linear abnormal signal intensity lesion with enhancement posteriorly up to the CP angle cistern segment of the trigeminal nerve. There are T1 hypo and T2 hyper intense signals involving the anterior right temporal lobe showing post-contrast enhancement.

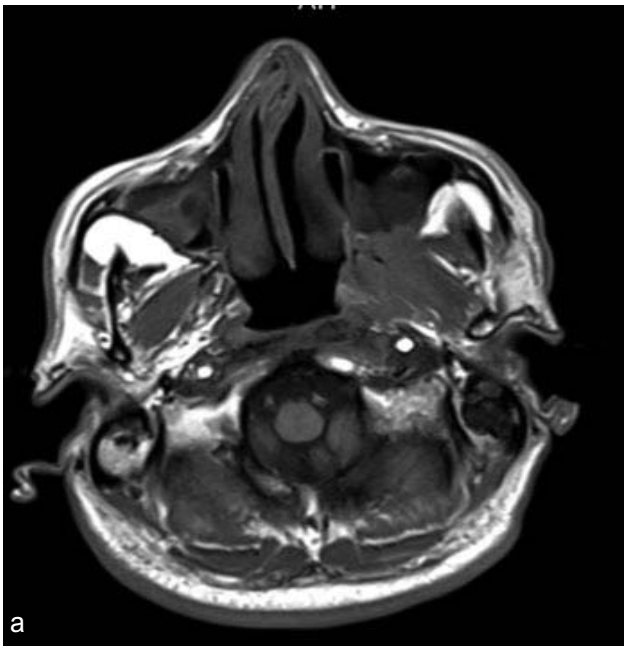
Figure 4g: T1 post-contrast coronal image reveals abnormal enhancing lesion in CP angle cistern segment of right trigeminal nerve.

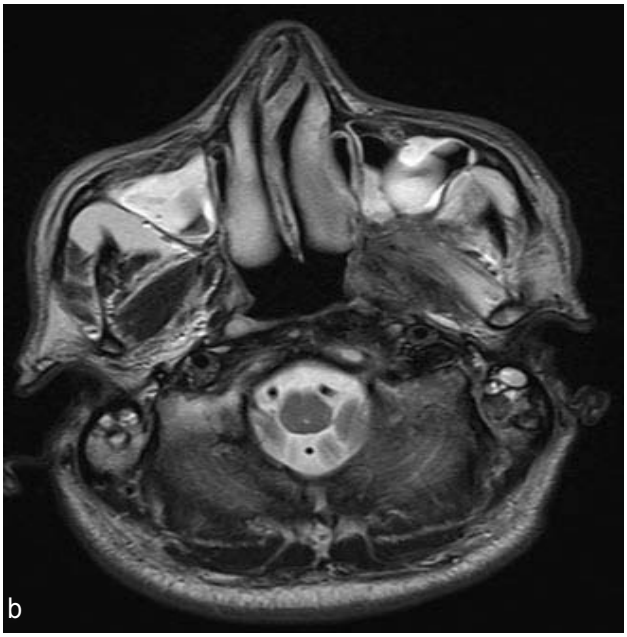
Figure 4h: T1 post-contrast sagittal image reveals re-demonstration of abnormal thickening and enhancement along the branches of trigeminal nerve extending up to Meckel s cave and CP angle cistern.

Histopathology revealed granulomatous tissue with fungal hyphae and consequently diagnosis of sinus fungal infection with intracranial extension was established. Following this, BDM levels were performed which were high. Patient was started on aggressive antifungal treatment under supervision of infectious disease team. On follow up, patient was doing well with interval decrease in BDM level.

Case 3

44 year-old male, known case of nasopharyngeal carcinoma since the past 16 years presented to the





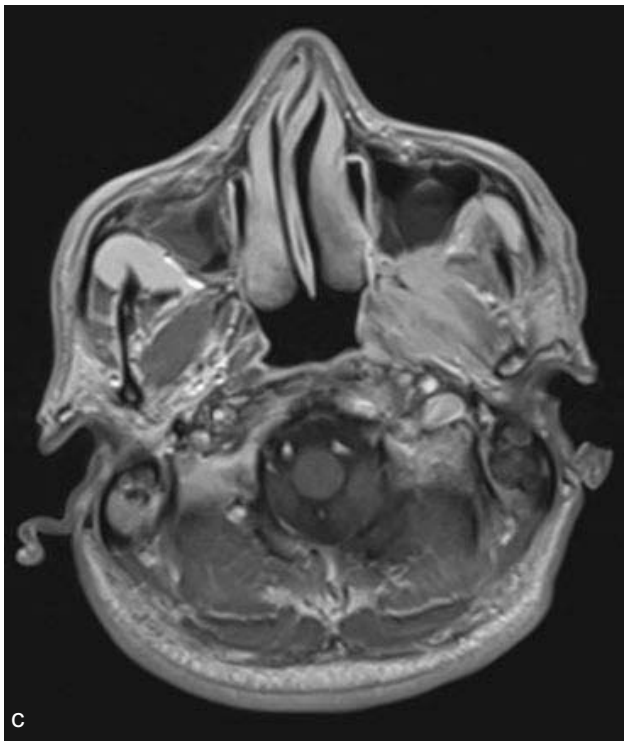
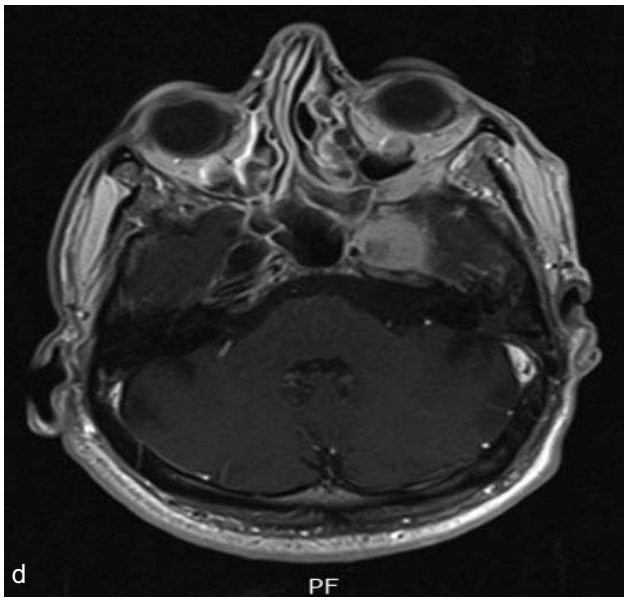


Figure 5a-c: T1, T2 and T1 post-contrast images reveal an abnormal signal intensity lesion in left nasopharyngeal soft tissues with extension into left maxillary sinus projecting into the nasopharyngeal air way. It appears iso-intense on T1 and hyper intense on T2-weighted images showing post-contrast enhancement.

radiation oncology outpatient clinic referred from ENT, with complaints of headache and double vision. He subsequently underwent MRI head and neck with contrast.



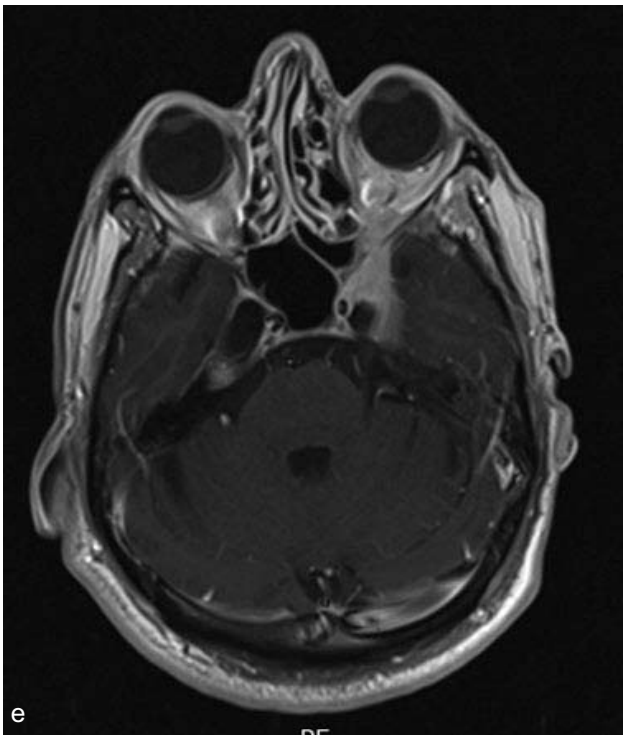


Figure 5d,e: Axial T1 post-contrast images reveal an abnormal enhancing lesion in the anterior part of the median temporal lobe with abnormal linear-enhancing signal in the left pterygopalatine fossa with corresponding image revealing extension of the abnormal signal up to the region of the cavernous sinus.

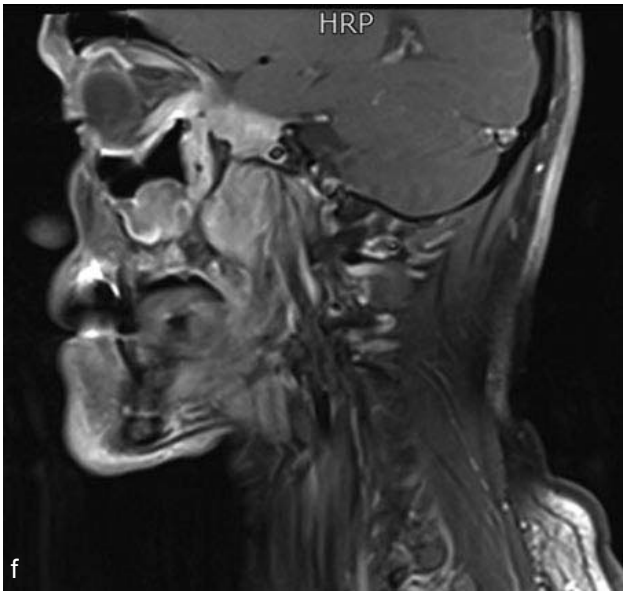


Figure 5f: T1 post-contrast sagittal image reveals abnormal thickening and enhancement of the mandibular division of the trigeminal nerve with extension up to Meckel s cave.

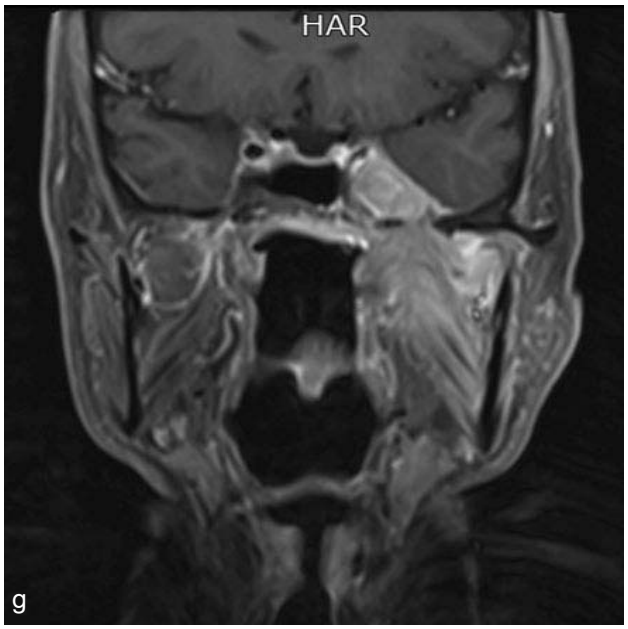
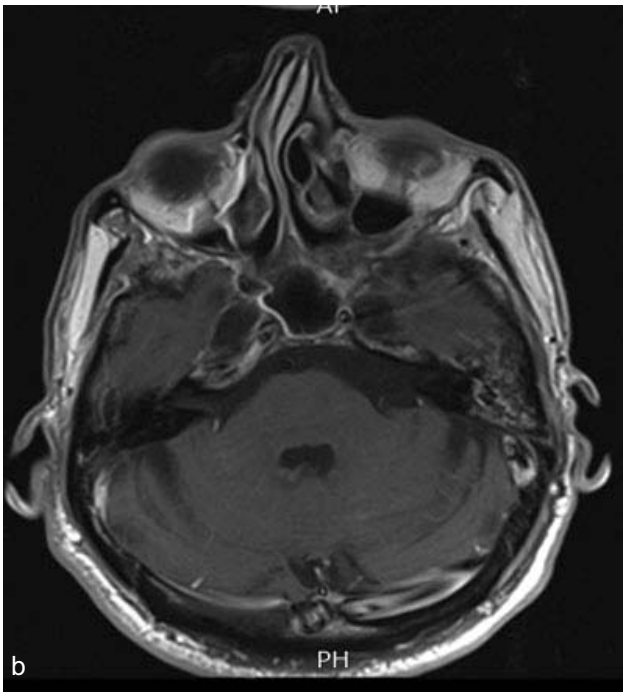
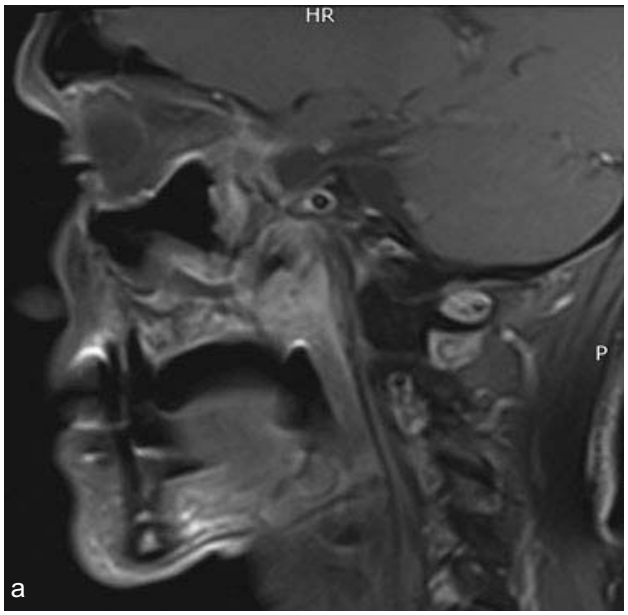


Figure 5g: T1 post-contrast coronal image reveals re-demonstration of abnormal thickening and enhancement in Meckel s cave along with abnormal enhancing lesion in the left nasopharyngeal soft tissue.



On the basis of imaging findings, diagnosis of neoplastic lesion in nasopharyngeal soft tissues with perineural spread was established. Histopathology was performed on which it turned out to be squamous cell carcinoma. Subsequently, wide field radiation and neoadjuvant chemotherapy was performed. Follow up MRI with contrast was performed after 6 months which revealed:-



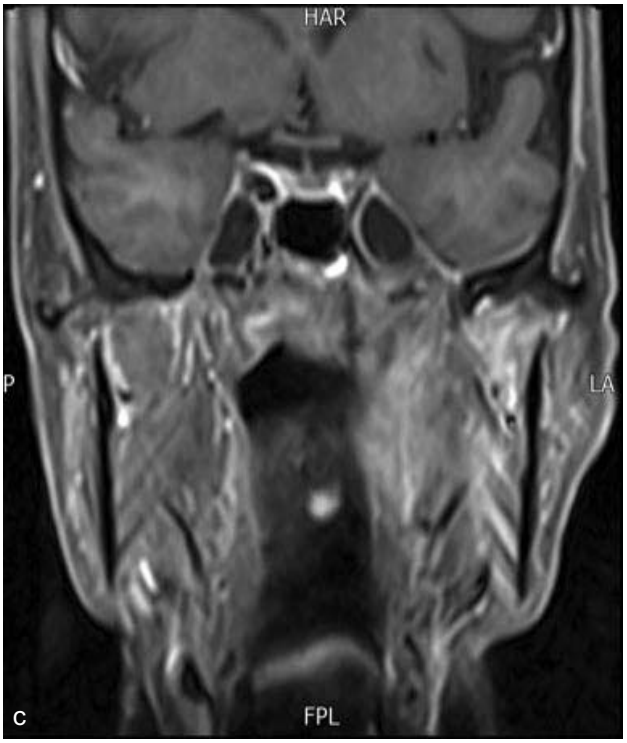


Figure 6a-c: Axial, coronal and sagittal T1 post-contrast images which reveal interval resolution of primary lesion with interval resolution of thickening and enhancement along the branches of trigeminal nerve.

Discussion

Perineural spread in head and neck malignancies is a well described phenomenon in surgical and imaging literature. It has an incidence of 30-50%.[10] It is considered an independent prognostic and staging marker irrespective of nodal status of the disease as Perineural spread is associated with poor prognosis resulting in increased incidence of recurrence reduced 5 year survival and more metastatic events.[11] Some of the histopathologic sub types of head and neck malignancies have a higher association with Perineural spread including squamous cell carcinoma, adenoid cystic and mucoepidermoid tumors of salivary gland.[12]

A prior study revealed that in series of 38 patients with perineural spread only 13 % of radiology reports had mention of perineural spread.[13] Since this entity has therapeutic implications hence radiologist needs to well aware and vigilant in identifying features of nerve involvement. Imaging features of nerve involvement including nerve thickening, enhancement, destruction of the foramina and secondary changes in muscles innervated by nerve involved are not unique to tumor spread along.[14] These features can also be seen in infective, inflammatory and primary nerve pathologies as well.[15]

Conclusion

In cases of head and neck malignancy, possibility of perineural spread should be kept in mind as this influences tumor staging, prognosis and therapeutic strategy.

However, features of nerve involvement are not unique to perineural tumor spread, and other possibilities discussed earlier should also be kept in mind.

Conflict of Interest: None

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