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## Case Report

# 18F-FDG PET, contrast CT and MRI to comprehensively diagnose and assess rare perineural spread of squamous cell carcinoma to the greater auricular nerve ☆,☆☆

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## ABSTRACT

We present a case of a 78-year-old male with a primary parotid squamous cell carcinoma which spread via the left facial, trigeminal and greater auricular nerves. The patient presented with left facial droop and paraesthesia. Initial MRI scans demonstrated involvement of the trigeminal and facial nerves with no sign of a primary lesion. Abnormal enhancement within the left parotid substance on FDG PET-CT demonstrated the primary malignancy which was confirmed on histology by core biopsy. There was also focal avidity along the course of the left greater auricular nerve consistent with perineural infiltration, extending from the posterior aspect of the parotid to the left cervical plexus at C2/C3. To our knowledge, this is the second case of squamous cell carcinoma perineural spread to the greater auricular nerve imaged on FDG PET-CT scanning. This case highlights the importance of multimodality imaging correlation in the workup of primary head and neck malignancies and associated perineural spread, which is essential in adjuvant radiation therapy planning to reduce local recurrence, improve prognosis and overall survival.

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## Introduction

Perineural spread (PNS) is common in head and neck cancer, particularly in squamous cell carcinoma (SCC), with the facial

and trigeminal nerves serving as common conduits for spread. Perineural spread refers to clinical or radiological evidence of tumour spread along a nerve. This can be contrasted with perineural invasion which refers to direct invasion of the tumour into the nerve and is diagnosed histopathologically.

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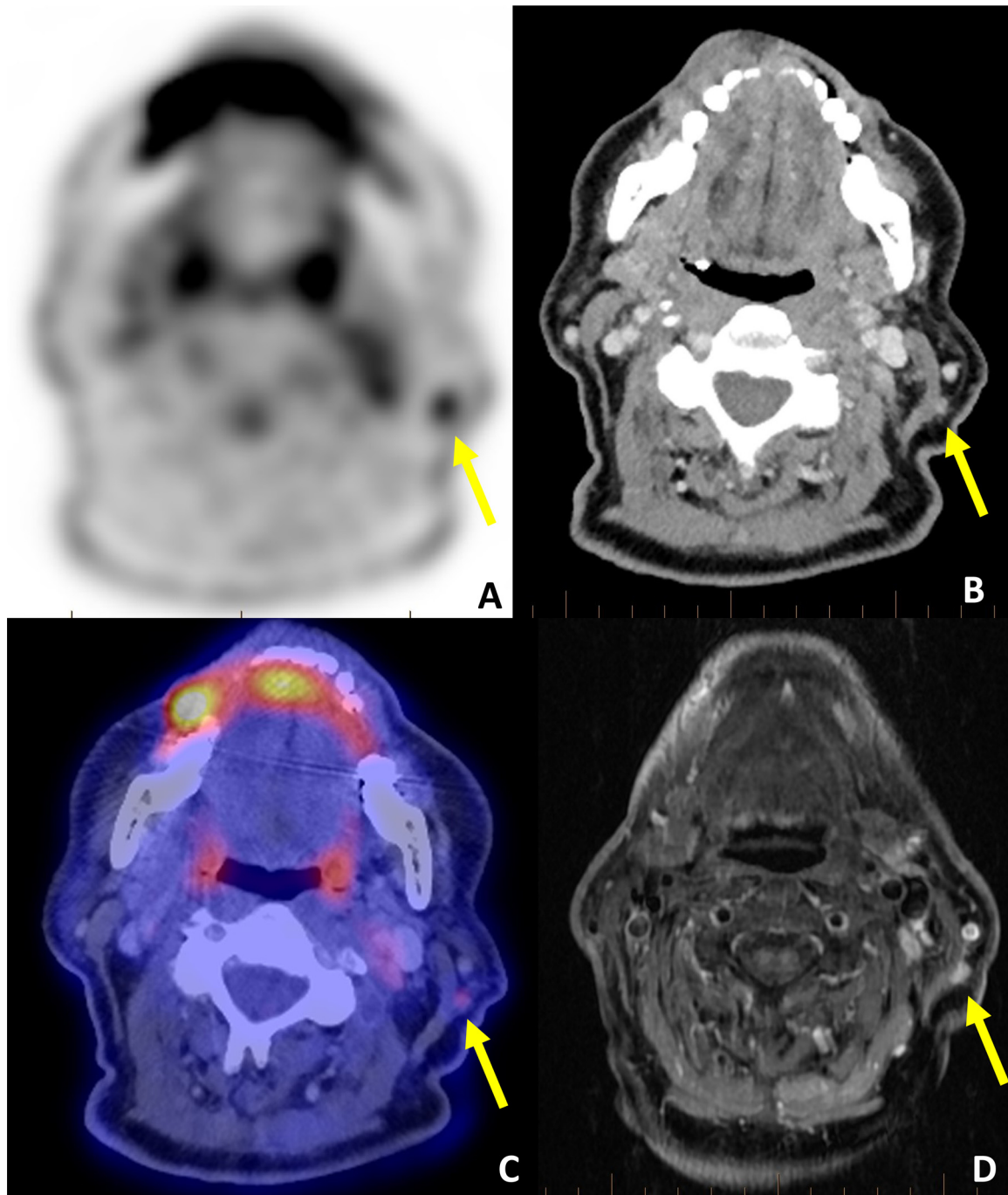
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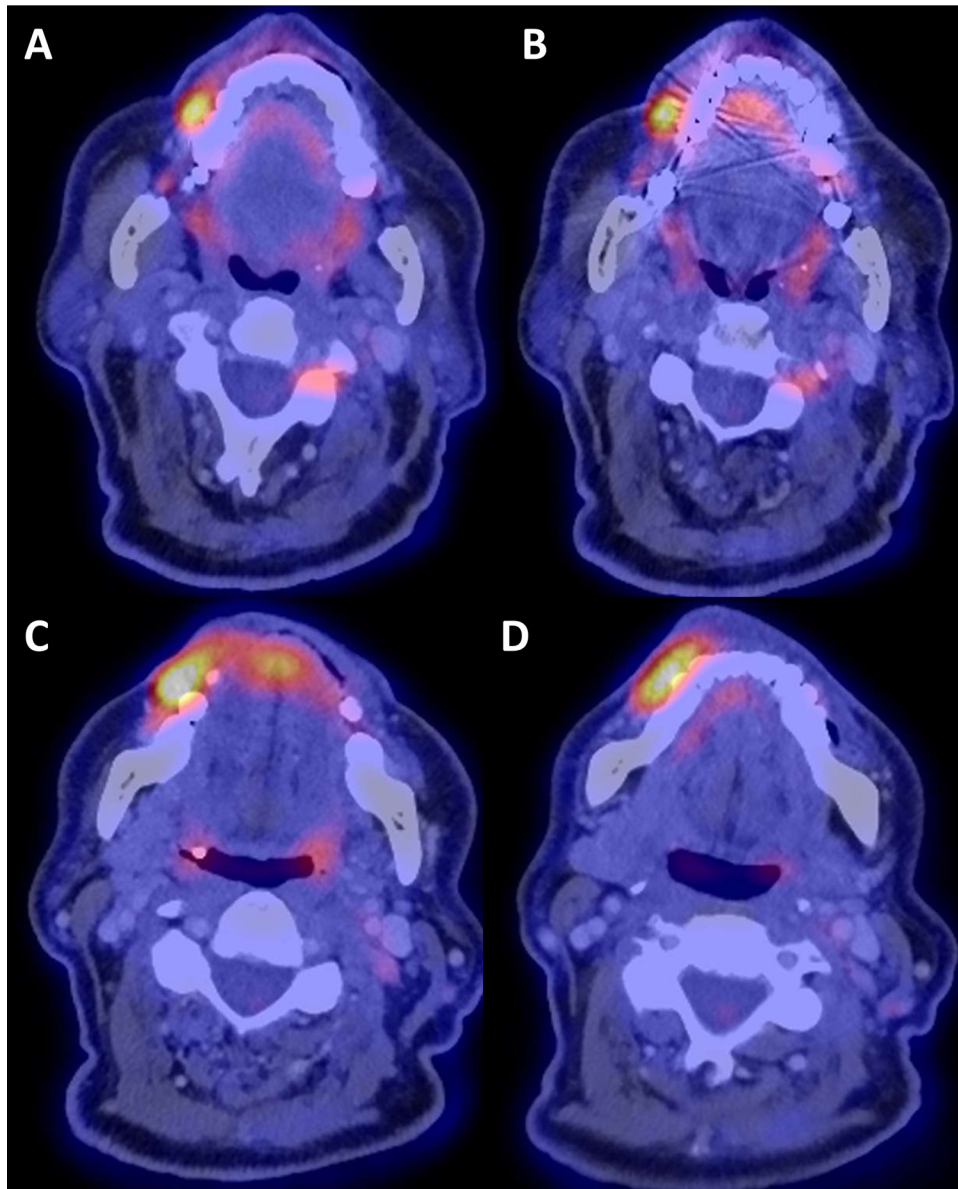
**Fig. 1 – Axial PET (A) and contrast enhanced axial CT (B) and fused PET/CT (C) images show moderate FDG uptake in an enhancing cord like structure coursing from the parotid gland, posteroinferiorly to the posterior margin of the sternocleidomastoid muscle and passing posterior to the left internal jugular vein and then toward C2/3. Axial T2FS contrast enhanced MRI (D) shows concordant enhancement and thickening of the left greater auricular nerve, consistent with perineural invasion.**

PNS plays an important role in prognostication as it is associated with higher rates of recurrence, metastasis and poorer survival and can alter management from surgical excision alone to include radiotherapy and neoadjuvant chemotherapy [1]. However, PNS is frequently overlooked on CT and MRI, highlighting the importance of PET-CT in the work-up of head and neck malignancies. To our knowledge, we describe the

second case of PNS to the greater auricular nerve (GAN) identified on 18F-FDG PET-CT scanning [2].

#### Case report

We present a 78-year-old man with a 2-week history of left-sided facial muscle weakness, left-sided headache, pain and



**Fig. 2 – Axial fused PET/CT images in series from cranial to caudal (A-D) show the course of the left greater auricular nerve from origin at left C2/3, passing caudally to posterior to the left internal jugular vein and then looping anteriorly over the sternocleidomastoid muscle.**

tingling of head. An MRI showed no pathology, and the trigeminal and facial nerves were normal bilaterally. On physical examination, there was no palpable mass within the parotid gland.

Four months later, the patient re-presented with progressive left facial droop and numbness. On subsequent MRI there was abnormal enhancing material within the left infratemporal fossa and left Meckel's cave associated with left CNV2 and CNV3 infiltration. Additionally, there was hyperintensity of the left muscles of mastication and left CN7 enhancement associated with mastoid fluid. Further imaging of the infratemporal fossa was recommended as this area was inadequately imaged.

A later neck MRI demonstrated PNS along the left facial nerve which entered the ipsilateral parotid gland and showed

patchy abnormal enhancement. However, there was no evidence of a primary malignancy. PET-CT was recommended to search for a malignancy.

<sup>18</sup>F-FDG PET-CT demonstrated abnormal enhancement within the left parotid confirming a primary malignancy, which confirmed invasive SCC histologically by core biopsy of the parotid. Activity extended from the parotid along the expected course of the left facial nerve to a focal area of activity between the left styloid process of the left mandibular ramus in the expected region of the stylomastoid foramen. The findings were strongly suspicious for perineural spread along the left facial nerve.

Additionally, there was an avid focal area within a linear structure passing from the posterior aspect of the parotid gland posteroinferiorly to the posterior margin of the stern-

ocleidomastoid muscle, looping around and passing deep to that muscle, passing posterior to the left internal jugular vein and then toward the left C2/C3 nerve root. This distribution was consistent with perineural infiltration of the left greater auricular nerve extending from the posterior aspect of the parotid to the left cervical plexus at C2/C3 (Figs. 1 and 2).

PET-CT images enabled accurate radiation planning for external beam radiation therapy which formed the adjuvant management in this case. At 3 years follow up, PET-CT has confirmed ongoing complete metabolic response and the patient continues in progression free survival.

## Discussion

Head and neck cancer refers to a broad, heterogeneous group of malignancies that affect the skin, oral cavity, nasal cavity, paranasal sinuses, salivary glands, pharynx, larynx and other structures. Among them, SCC is the most common type of head and neck cancer [3]. Tumours in the head and neck can spread via several different mechanisms, including direct extension as well as haematogenous and lymphatic spread.

Certain tumours use nerves as a conduit for spread whereby the tumour grows between the nerve and its sheath, termed perineural spread. The pathophysiology is poorly understood with previous theories suggesting mechanical growth of tumour cells along the path of least resistance or spread via epineural lymphatics however these have been rejected [4]. More recent theories suggest a complex interaction between nerve and tumour cells with upregulation of genes which increase cell proliferation and downregulation of apoptotic genes involving pro-invasive signals [4,5].

The rate of PNS in head and neck SCC is quite varied due to studies of different sample size, detection method and site of cancer. It also differs between cutaneous and non-cutaneous SCC. The former is estimated between 2.4% and 14% whereas the latter ranges between 14.2% and 63.2% [5,6]. The most commonly affected nerves are the trigeminal and facial nerves and their branches, likely due to their extensive innervation of head and neck structures. According to Gandhi, in decreasing incidence affected nerves include the infraorbital, frontal, facial, auriculotemporal and mandibular nerves [7]. More rarely is the greater auricular nerve and cervical plexus involved with less than 10 cases found in reported literature [8]. Clinical presentations varied with some patients experiencing similar paralysis and formication to this case while others were asymptomatic with an abnormal GAN found on ultrasound and biopsy.

Several studies have found that PNS adversely affects prognosis and is associated with increased local recurrence and decreased survival [5,9,10]. Local recurrence has been reported to increase from 5%-9% to 23%-36% [11]. One study found disease-specific mortality increases from 25% to 54%, another from 45% to 78% [11,12]. Furthermore, the presence of PNS alters surgical and radiotherapy management. Careful preoperative assessment guided by imaging is required to ensure clear surgical margins. Radiation fields should be widened at the tumour bed due to the increased chance of local recurrence [13].

Overall, the combination of surgery and adjuvant radiotherapy offers the best chance of survival.

This case highlights the importance of multimodality imaging correlation in the workup of head and neck PNS. MR neurography is the gold standard in the diagnosis of PNS with a reported sensitivity and specificity of 95% and 90% respectively [7]. Our findings demonstrate the added value of PET/CT metabolic assessment to MRI, as the metabolic extent of the GAN PNS was greater. Furthermore, co-acquisition of PET with diagnostic contrast CT as opposed to low dose CT, afforded superior imaging resolution and anatomical detail necessary to comprehensively delineate the extent of PNS. This in turn influenced the planning for radiation therapy that has led to long term disease control in this patient.

## Patient's consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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