

# Are We Following the Best Practice when Imaging for Pulsatile Tinnitus?

## A Five Year Audit of 4D-CTA Referrals at a Tertiary Neuroradiology Centre

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### Introduction

Pulsatile tinnitus (PT) is a heartbeat-synchronous sound and can be subjective or objective. It warrants thorough investigation as it may indicate potentially serious conditions such as arteriovenous malformations, vascular tumours, or intracranial hypertension. MRI/MRA±MRV are used for suspected vascular aetiology, and CT temporal bones if hearing loss is present. 4D-CTA is reserved for dynamic problem-solving, surgical planning, or when prior imaging is inconclusive. Unlike conventional imaging, 4D-CTA incorporates a time-resolved component, enabling the visualisation of blood flow dynamics within vascular structures and their relationships to surrounding tissues. Compared to digital subtraction angiography, which remains the gold standard for identifying vascular abnormalities, 4D-CTA provides a less invasive method for evaluating vascular causes with reduced procedural risks.

### Aim

To assess whether patients investigated for PT received appropriate first line imaging before undergoing 4D-CTA.

### Methods

All patients who had 4D-CTA head at the Walton Centre for the investigation of pulsatile tinnitus between September 2019 - September 2024 were included in this study. Patient notes were reviewed for history of carotid bruits and hearing loss, previous imaging modalities and findings on previous images.

### Results

Thirty-five patients underwent 4D-CTA (mean age 53; 8 male, 27 female). Hearing loss was recorded in 8/35, a carotid bruit in 1/35 and previous embolised AVM in 1/35 and 25/35 patients did not have any associated hearing loss.

- Without hearing loss/bruit/known AVM, only 5/25 (20%) had an initial MRA/MRV.
- With hearing loss, 0/8 (0%) had a prior CT temporal bones.

**Impact of 4D-CTA:** pathology was identified in 9/35 (25.7%): dAVF (n=4), high-riding jugular bulb (n=1), extracranial fibromuscular dysplasia (n=1), bilateral carotid canal dehiscence (n=1), right transverse-sinus stenosis (n=1), persistent trigeminal artery (n=1).

4D-CTA confirmed abnormalities from other imaging in 4/35 (11.4%) and excluded previously suspected causes in 5/35 (14.3%).

Overall, 7/35 (20%) of patients had appropriate first-line imaging before 4D-CT.

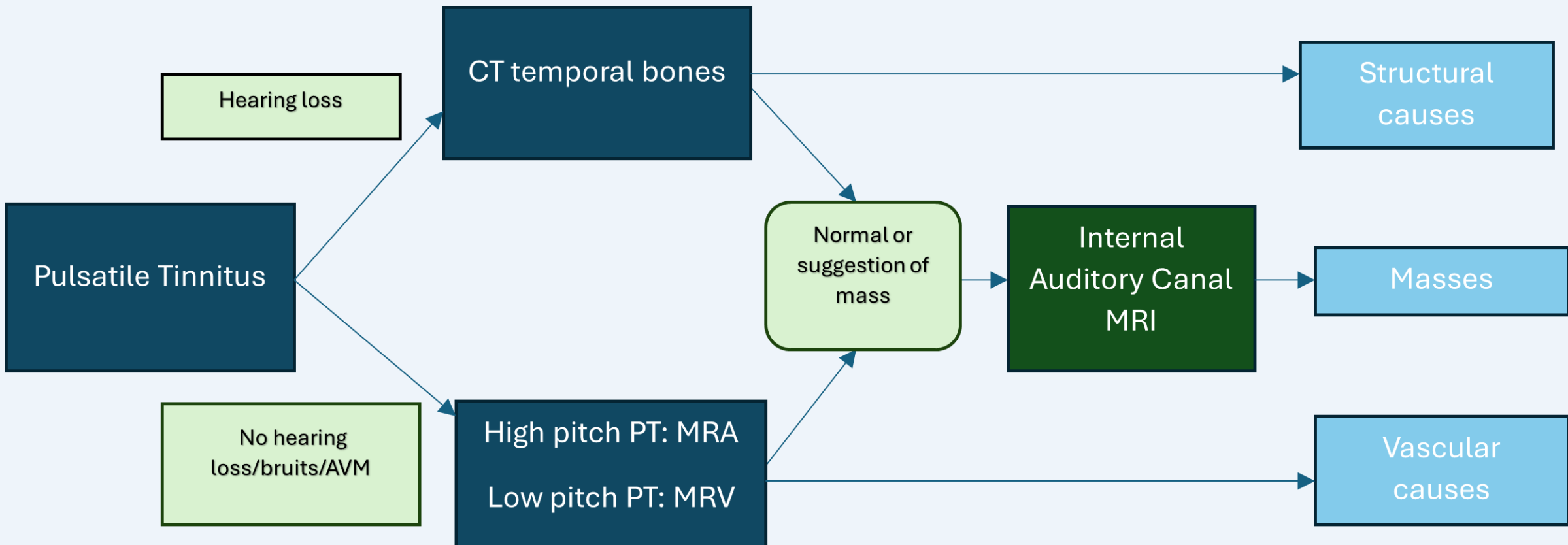


Figure 1:<sup>1</sup>Initial assessment: confirm pulsatility, examine for bruits; audiology ± tympanometry; red flags. First line imaging: hearing loss/otological → CT temporal bones; vascular suspicion/bruit → MRI/MRA±MRV. Second line: 4D-CTA for dynamic flow characterisation, surgical planning or equivocal prior imaging; DSA if high suspicion persists.

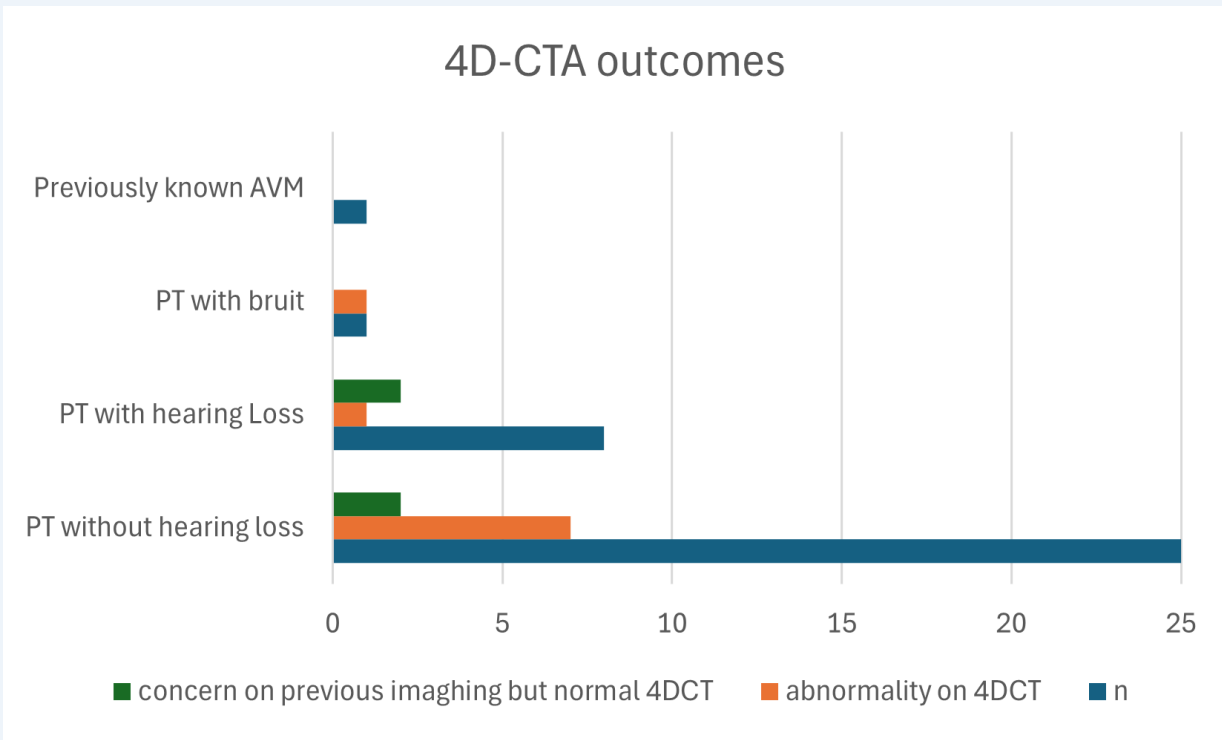


Figure 2: Demonstrates the number of patients receiving 4DCT based on symptoms, concern regarding pathology on previous imaging and pathology.

Table 1: The pathologies identified on 4D-CTA.

| 4D-CTA Identified Abnormalities/ Anatomical variants | n |
|------------------------------------------------------|---|
| AV shunt - DAVF                                      | 4 |
| High riding jugular bulb (Lt)                        | 1 |
| Extra-cranial FMD                                    | 1 |
| Bilateral carotid canal dehiscence                   | 1 |
| Right TS stenosis                                    | 1 |
| Persistent trigeminal artery                         | 1 |

### Discussion

MRA/MRV and CT temporal bones are essential first-line imaging modalities in the evaluation of pulsatile tinnitus due to their non-invasive nature, ability to identify common causes, and relatively low risk.

4D-CTA head imaging should be reserved for cases where dynamic blood flow visualisation is necessary, surgical planning, follow up or where initial findings are inconclusive.

In our centre, first-line imaging for PT was frequently suboptimal. The omission of temporal bone CT in patients with hearing loss likely reflects the fact that referrals from the tertiary neurology centre were primarily to exclude vascular shunting lesions. Adopting a simple, symptom-driven local pathway and reserving 4D-CTA for dynamic assessment should improve diagnostic yield while reducing radiation, contrast exposure and cost.

### References:

<sup>1</sup>Imaging of Pulsatile Tinnitus, [Suehyb G. Alkhatib](#), [Sandeep Kandregula](#), [Kelley Flesher](#), [Omar A. Choudhri](#), [Jason A. Brant](#), [Suyash Mohan](#),. Raadiographics (2024)