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Original Article

# The Agreement between Protocols for the Investigation of Asymmetrical Audiovestibular Symptoms

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**OBJECTIVE:** There are a number of published criteria for the investigation of asymmetrical audiovestibular symptoms. Our aim was to determine the agreement between these protocols when determining whether to investigate a group of patients treated at our institution.

**MATERIALS and METHODS:** Retrospective audit of the indications for arranging 854 consecutive magnetic resonance imaging scans of the internal auditory meatus. These indications were compared to the Oxford, Northern, Charing Cross, and Nashville guidelines on the investigation of asymmetrical audiovestibular symptoms.

**RESULTS:** The level of agreement was low, with kappa values ranging between 0.15 and 0.58 between the four selected protocols.

**DISCUSSION:** While these criteria seem very similar in nature, due to the number of patients with mild asymmetry and subtle distinctions such as the inclusion or exclusion of tinnitus, there are low levels of agreement between protocols. This study highlights another area of difficulty when determining which patients to investigate.

**KEYWORDS:** Magnetic resonance imaging, acoustic neuroma, tinnitus, hearing loss

## INTRODUCTION

There is an ongoing debate on the need to investigate the possibility of acoustic neuroma in patients with asymmetrical audiovestibular symptoms. The British National Study of Hearing demonstrated that 2.9%-10.4% of the population in the UK had interaural asymmetry of a hearing level of 15 decibel (dB) or more, at one or more frequencies, depending on the frequencies tested. It is not practical to investigate all these patients for the possibility of acoustic neuroma. From the large number of publications on this topic, the following is clear.

First, acoustic neuroma (vestibular schwannoma) is an uncommon finding when asymmetrical audiovestibular symptoms were investigated; the detection rate is generally around the order of 1% [1, 2]. Interestingly, we do not have a clear idea of the true incidence of acoustic neuroma. Traditionally, cadaveric studies have been reported to demonstrate around a 1% incidence [3]; however, these are based on large selected series of temporal bones collected by academic institutions. It is unlikely that this constitutes a representative sample. Based on studies performed in the United Kingdom (UK), Denmark, and Canada, the annual incidence is thought to be between 0.5 and 2 in one hundred thousand people [4, 5].

Second, it is important to detect acoustic neuroma early. While most tumors are simply observed, early detection of enlarging tumors allows for treatment options including stereotactic radiosurgery to be considered. Furthermore, while these tumors are considered relatively indolent, growth rates of over 18 mm/year have been reported [6].

In order to harmonize these competing considerations, different recommended protocols have been published. The issue was also addressed by the National Institute for Health Research's Health Technology Assessment Programme [7], which published directions for the use of magnetic resonance imaging (MRI) of the internal acoustic meatus (IAM), but opted not to recommend a single investigation protocol. The current situation is variable, and depending on the department you attend or the clinician you consult, you may or may not be investigated.

In a busy UK district general hospital ear, nose and throat (ENT) department with nine consultants, a large number of scans are requested each year. The department does not currently have a single preferred protocol. We audited the results of 1000 MRIs of the IAM and checked our concordance with a number of these published protocols. We also determined whether there was agreement among each protocol on whether a scan was indicated or not.

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## MATERIALS and METHODS

### Study Design and Setting

At our institution, a UK district general hospital, we obtained a list of 1000 consecutive MRIs of the IAM from a prospectively collected radiology database (General Electric; Fairfield, USA). Clinical records were searched, and patient demographics, indications, and findings were analyzed. A prospectively collected audiology database (Auditdata; Taastrup, Denmark) was searched and hearing tests were correlated with imaging requests.

### Statistical Analysis

Statistical analysis was undertaken using Graphpad (Graphpad; La Jolla, USA) to calculate kappa coefficients. These were used to determine the level of agreement between the protocols to determine which patients should undergo imaging.

### Ethical Considerations

The study was performed as part of a service evaluation project and therefore formal ethical approval was not required.

## RESULTS

### Overall Results

One hundred and forty-six scans were not performed as part of the investigation of asymmetrical audiovestibular symptoms, but rather as part of a research project for the investigation of cholesteatoma, and were therefore excluded. Of the remaining 854 scans, we found 9 acoustic neuromas (1.1%). This was very similar to previously published series. In addition, 3.5% of scans had findings that could explain hearing loss, such as a meningioma near the IAM, abnormalities of the inner ear, and an arachnoid cyst impinging upon the auditory cortex. 35% of scans had purely incidental findings, most frequently, chronic ischemia.

### Indications for Imaging

Unilateral or asymmetrical hearing loss was the most frequent cause for investigation. Scans were also requested to investigate tinnitus and vertigo, or the above symptoms in combination. The symptomatology leading to investigation is shown in Figure 1.

In our analysis of the criteria for imaging and their agreement, patients referred on the basis of vertigo or dizziness were excluded. This was the case even when these symptoms formed only part of the indication (e.g., vertigo and tinnitus). This was based on the fact that published criteria almost invariably either do not comment on indications for imaging in these cases, or leave it to the physician's discretion. Our patient group meeting this criteria comprised 157 investigations. A further 72 scans were requested for other miscellaneous criteria such as trigeminal nerve symptoms. This left 625 scans for which agreement on audiological criteria was determined.

91% of these scans met the criteria from one or more published guidelines. However, of the scans requested, only 44%-90% met the criteria of any one individual guideline (Table 1) [8-11]. The reason for this disparity was the poor concordance between the criteria in the published scanning guidelines. This occurred notably when considering whether investigation of unilateral tinnitus was warranted; however, it also occurred on the basis of the degree of asymmetry required.

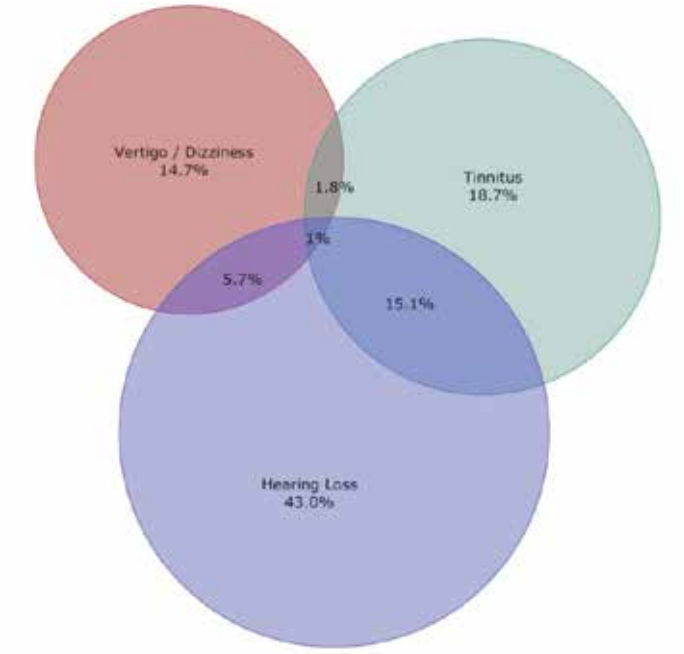


**Figure 1.** Symptomatology leading to investigation with MRI of the IAM

**Table 1.** Concordance with published guidelines

| Guideline | % of scans concordant with that guideline |
|---|---|
| Oxford Guideline [8]. 15 dB asymmetry between mean thresholds of tested frequencies+Unilateral tinnitus with normal hearing. | 52 |
| Northern Guideline [9]. 20 dB asymmetry between two contiguous frequencies+Unilateral tinnitus. | 73 |
| Charing Cross Protocol [10]. 20 dB asymmetry between two contiguous frequencies or 15 dB if normal hearing in one ear. | 44 |
| Nashville Otology Group [11]. 15 dB asymmetry at one frequency 0.5–4 kHz+Unilateral tinnitus. | 90 |

dB: decibel

### Agreement between Protocols

We calculated kappa coefficients to assess the agreement between protocols on which of these patients should or should not be imaged. The results are shown in Table 2. Poor agreement between these protocols is demonstrated in our cohort.

## DISCUSSION

While these criteria seem very similar in nature, due to the number of patients with mild asymmetry and subtle distinctions such as the inclusion or exclusion of tinnitus, there are low levels of agreement between protocols.

The lack of agreement among published scanning protocols causes a number of difficulties for the clinician. For example, if the clinician follows a protocol that does not recommend the routine investigation of unilateral tinnitus, the patient may feel aggrieved if they independently find other protocols recommending investigation. If they have an acoustic neuroma or other relevant finding, this issue could easily lead to litigation. Equally, the clinician who decides to image

**Table 2.** Agreement between scan protocols in our cohort. A kappa value of 0.7 represents good agreement

| Protocol comparison | Kappa value |
|---|---|
| Oxford-Charing Cross | 0.15 |
| Oxford-Northern | 0.58 |
| Charing Cross-Northern | 0.31 |
| Charing Cross-Nashville | 0.15 |
| Northern-Nashville | 0.44 |
| Nashville-Oxford | 0.20 |

any patient indicated by any protocol will first have to juggle dozens of published protocols and second image a great number of patients, with significant findings being exceptionally uncommon.

Could it be said that there is a rationale for having protocols relevant for each department based on the caseload that presents to that center? There is no convincing evidence that patient demographics affects the way that patients with acoustic neuroma present to hospital, although it is not impossible.

Given the relatively small number of positive findings in this group, the purpose of this study is not to determine which of the tested protocols is most accurate in identifying these patients. A much larger study is required for that purpose, and with the advent of a national acoustic neuroma database, it may be soon possible.

There would be great benefits to the agreement of a single protocol between each national association of ENT surgeons, audiologists, and neuro-otologists. These include a rationalization of the number of scans requested, a robust position to take if patients feel unhappy about investigation decisions, and a position of clarity for ENT surgeons working in that area.

In conclusion, there is a poor level of agreement between the large number of published protocols for the investigation of asymmetrical audiovestibular symptoms. Agreement on a single protocol would be greatly beneficial.

**Ethics Committee Approval:** The study was performed as part of a service evaluation project, approved as part of the ongoing departmental audit program. Further ethical approval was not required.

**Peer-review:** Externally peer-reviewed.

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