

# Electrocochleography & Subjective Measures for the Diagnosis of Ménière's Disease

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## Abstract

This study investigated the inter-method reliability of the diagnosis of Ménière's disease (MD) between electrocochleography (ECoChG) measures and the subjective scores based on the clinical guidelines provided by the American Academy of Otolaryngology-Head and Neck Surgery Committee on Hearing Equilibrium (AAO-HNS CHE) and the Gibson's Score. A total of 250 potential MD patients who have had their MD-related signs and symptoms documented and ECoChG testing completed in the Department of Otolaryngology at Christchurch Hospital were included. A selection of details obtained from both the AAO-HNS CHE and ECoChG testing results were examined to allow for an investigation on the function of these methods as a diagnostic tool for MD. The inter-method reliability between ECoChG and the two subjective methods for the diagnosis of MD was found to be high. In addition, patients that tested "positive", regardless of the diagnostic method used, showed a higher correlation among the four key symptoms of MD. These results demonstrate that ECoChG is an effective diagnostic tool but should not be used as the sole assessment for the diagnosis of MD. This research provides empirical evidence in support of using ECoChG as an effective tool as part of the differential diagnosis of MD.

## Introduction

Ménière's disease (MD) is an idiopathic inner ear disorder (Ries, Rickert, & Schlauch, 1999). It is characterised by episodes of vertigo, roaring tinnitus, fluctuating sensorineural hearing loss, and a sense of aural fullness that can fluctuate over months and years (Sajjadi & Paparella, 2008). The variability of symptomological changes renders it difficult to diagnose.

The diagnosis of MD is almost universally made using the clinical guidelines set by the American Academy of Otolaryngology-Head and Neck Surgery Committee on Hearing and Equilibrium (AAO-HNS CHE) (Members of the Committee on Hearing and Equilibrium, 1995). An alternative is the 10 point Gibson score (Gibson, 1991). Both of these tests are subjective, symptom-based assessment for MD, classifying patients as "definite MD" or "probable" if a diagnosis of MD is highly indicated and "possible" if not. In addition, it has been suggested that Electrocochleography (ECoChG), which is an objective test of the cochlea's summating potential (SP), can be used for the diagnosis of MD with the parameters outlined by Gibson (1994).

It has been verified through histological studies (Horner, 1991) that individuals with MD exhibited excessive amount of endolymph leading to swelling of the boundaries of scala media in the cochlea (Hall, 2007). However, the change of endolymphatic hydrops (EH) can only be examined through post-mortem biopsies (Roeser, Valente, & Hosford-Dunn, 2000). To monitor the change of EH in vivo, an ECoChG recording can be obtained. An increase of EH has been found to result in an increased summation potential (SP) in response to clicks and tone bursts, with individuals with MD often found to exhibit an abnormally large SP (Conlon & Gibson, 2000). The increase of EH can also affect the magnitude of action potential (AP), which represents a collective response from synchronous firing of nerve fibres and is usually larger than the SP (Ferraro & Durrant, 2002; Hall, 2007). These responses are illustrated in Figure 1.

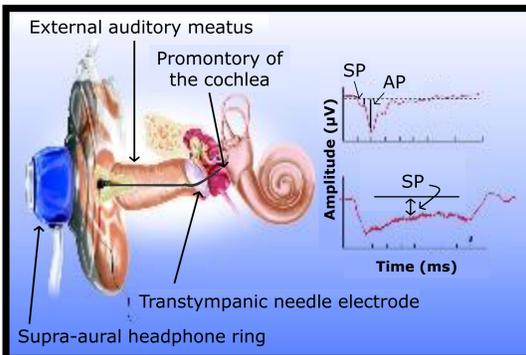


Figure 1. An artist's impression of transtympanic ECoChG in response to click stimuli (top right) and tone bursts (bottom right)

The correspondence between the AAO-HNS CHE and ECoChG methods as diagnostic tools for MD is evaluated in this study through report of the between-method reliabilities, including total, point-by-point, occurrence, and non-occurrence reliabilities.

## Research Questions

1. How does the method of ECoChG compare to the AAO-HNS CHE criteria and Gibson's score in detecting MD?
2. What are the characteristics of the patients tested "positive" with the ECoChG measures as compared with those classified by the other two subjective measures?

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## Methods

### Participants

A total of 250 patients (116 females and 133 males; age range: 9 – 88 years of age) whose medical records showed inclusion of an examination for Ménière's disease were included. The examination for MD was conducted between the years of 1993 and 2009. Each subject had their signs and symptoms documented and ECoChG testing completed.

### Instrumentation

**Electrocochleography:** Electrodiagnostic system (Amplaid MK 15, Milan, Italy), including electrodes, sterilised transtympanic needle electrode, phenol, elastic bands, and a supra-aural headphone ring.

**Database software:** Microsoft Access 2002

### Procedure

Patients were examined for Ménière's disease in the department of Otolaryngology at the Christchurch Hospital. Clinical examination consisted of a hearing test by an Audiologist, evaluation by an Otolaryngologist, and ECoChG testing conducted by both an Audiologist and Otolaryngologist. Transtympanic ECoChG testing responses were elicited using air conduction tone burst and click stimuli (Figure 2). The assessment records were retrieved and the data entered into a computer database for analysis.

## Results

The inter-method reliability between the ECoChG method and the two subjective methods (AAO-HNS CHE criteria and Gibson's score) for the diagnosis of MD was found to be high (Figure 4).

ROC curves were obtained for the two subjective methods and compared with the ECoChG diagnosis. The results demonstrated that ECoChG measures were highly pertinent to the diagnosis of Meniere's disease (Figure 3).

In addition, patients that tested "positive", regardless of the diagnostic method used, showed a higher correlation among the four key Meniere's symptoms. There was also a higher correlation between ECoChG measures at adjacent frequencies and a lower variation of SP/AP ratios across frequencies in the "positive" group as compared with the "negative" group.

## Conclusion

This study highlighted some important points relating to the assessment of Ménière's disease using different approaches. It can be concluded that the ECoChG method in this study showed a relatively high agreement with the two subjective methods in the diagnosis of MD. Mixed results from previous ECoChG studies have had limited the clinical application of the ECoChG method (Gibson, 2009). It was concluded from this study that ECoChG is an effective diagnostic tool but it should not be used as the sole assessment tool for the diagnosis of MD as its effectiveness may be dependent on the patient having full symptoms of the disease at the time of testing. It is important that professionals are aware of the disagreement between these three tests and the advantage of using ECoChG in combination with other assessment tools for the diagnosis of MD. The finding that patients with a positive diagnosis tended to exhibit higher correlations between ECoChG measures across frequencies needs further investigation. Development in the area of MRI may provide better validation for the diagnostic tools of MD and open up this area of research extensively in the future.

## Acknowledgements

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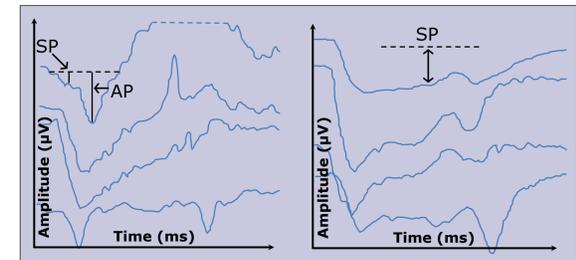


Figure 2. Transtympanic ECoChG in response to tone burst stimuli in an ear without EH (left) and with EH (right). The waveforms represent responses at four frequencies: 500, 1000, 2000, and 4000 Hz

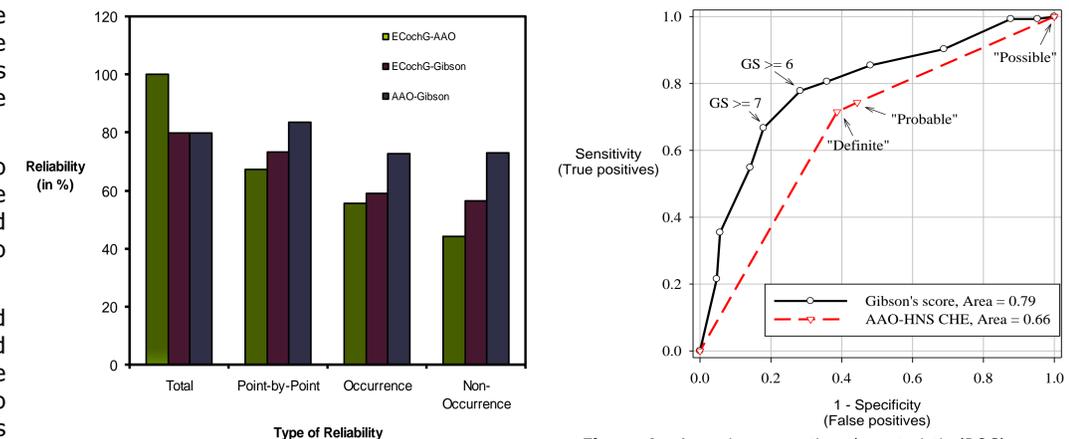


Figure 3. Total, point-by-point, occurrence, and non-occurrence reliability between ECoChG measures and the AAO-HNS CHE criteria, between ECoChG and Gibson's score, and between AAO-HNS CHE criteria and Gibson's score

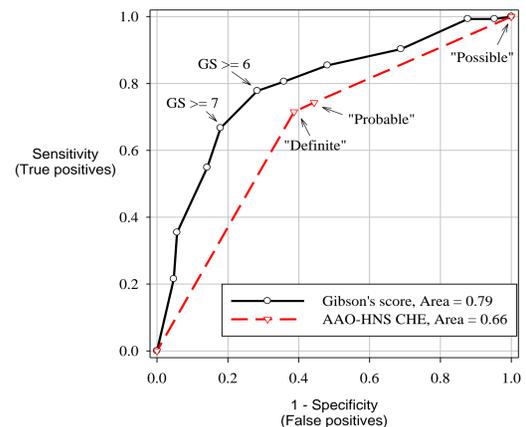


Figure 4. A receiver operating characteristic (ROC) curve showing the relationship between sensitivity and 1-specificity of the Gibson's score test at 11 cut-off points (right from left 0 to 10) and that of the AAO-HNS CHE test at 3 cut-off points ("possible", "probable", and "definite")

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