Recommended Procedure

Rinne and Weber tuning fork tests

Date: February 2022

Due for review: February 2027

OD104-51 v2 February 2022

General foreword

This document presents Practice Guidance by the British Society of Audiology (BSA). This recommended procedure represents, to the best knowledge of the BSA, the evidence-base and consensus on good practice, given the stated methodology and scope of the document and at the time of publication.

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Published by the British Society of Audiology

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With thanks to: All of the feedback received in the membership consultation in particular the Royal College of General Practitioners.

Citation

Please cite this document in the following format:

BRITISH SOCIETY OF AUDIOLOGY, (2022), Recommended Procedure Rinne and Weber Tuning Fork Tests [Online]. Available from: insert web link. [Accessed date]

Shared Decision-Making

It is implied throughout this document that the service user should be involved in shared decision-making when undertaking audiological intervention, receiving subsequent information and understanding how it will impact on the personalisation of care. Individual preferences should be taken into account and the role of the clinician is to enable a person to make a meaningful and informed choice. Audiological interventions bring a variety of information for both the clinician and the patient which can be used for counselling and decision-making regarding technology and anticipated outcomes.

Contents

1. Introduction

1.1 Background and scope

The purpose of this document is to describe guiding principles for safe and effective tuning fork testing carried out in any audiological context, with both children and adults.

The term 'shall' is used in this document to refer to essential practice and 'should' is used to refer to desirable practice.

This document describes a single method for the Rinne and Weber tuning fork tests which are simple to carry out. Implicit throughout this recommended procedure is an acknowledgement that any tuning fork test provides only limited indications on the type of hearing loss present and only at the frequency of the tuning fork being used. It is no substitute for further audiological assessment. In a primary care setting it is suggested that tuning fork testing is effective only as part of a screening programme for hearing loss and should not be the sole indicator on which a decision for further audiological assessment is based.

Tuning forks are used as a simple and brief test to establish the probable presence or absence of a significant conductive element to hearing loss. They are typically used to provide early diagnostic information when audiometry is not available or possible.

There are a number of different tuning fork tests, in literature the Rinne and Weber test are complementary to each other and for the purpose of this document are the only tuning fork tests described. The tests shall be undertaken together rather than independently. Information on the sensitivity and specificity of these tests can be found on pages 8 and 9.

1.2 Development of the recommended procedure

Unless stated otherwise the principles described here represent the consensus of expert opinion and received wisdom as interpreted by the BSA Professional Guidance Group (formerly the Professional Practice Committee) in consultation with its stakeholders. The document was developed in accordance with BSA guidance development protocols.

2. General considerations

The practitioner shall be competent, or supervised by someone who is competent, in tuning fork tests. Competence should be evidenced by sufficient and relevant training, experience and assessment.

2.1 The Tuning Fork

The preferred tuning fork is a 512Hz tuning fork. At this frequency, in comparison to the 256Hz and 1024 Hz tuning forks, the tone does not fade too quickly, produces limited overtones and is not vibrotactile (Khanna et al, 1976 & Tonndorf, 1968).

When struck accurately the tuning fork should be heard with 40-50 dBHL of bone conduction hearing threshold levels. (Thiagarajan & Arjunan 2012).

2.2 Striking the Tuning Fork

Ensure you use a tuning fork designed for audiometric examination, which must include a footplate and there should be no damage or chips to the tines prior to use. (Figure 1).

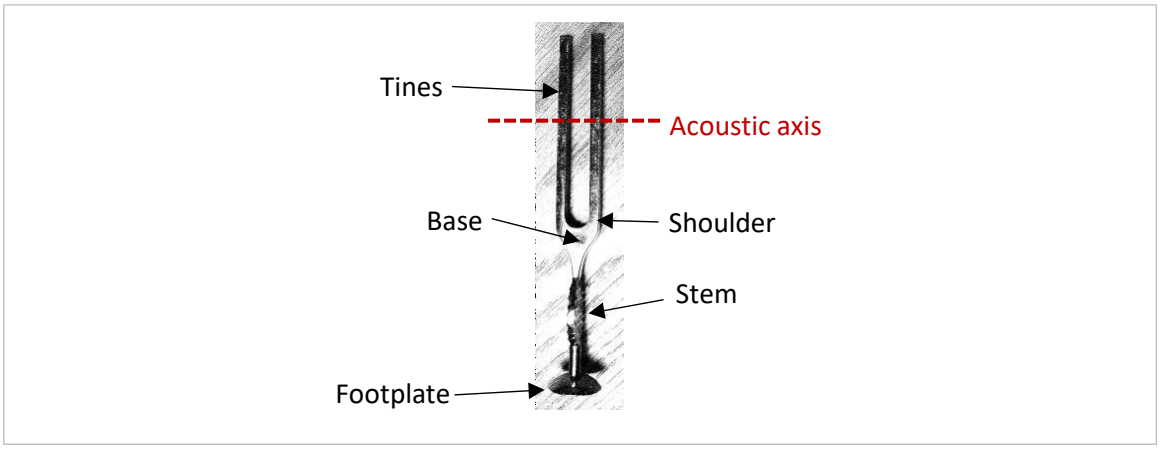

Figure 1 – The tuning fork

The practitioner shall hold the tuning fork by its stem and strike one side of the tines, two thirds of the way along the tine from the base, on a padded surface or the practitioner's elbow or ball of hand. Do not strike on a hard surface as this will introduce harmonic overtones and may damage the tuning fork.

3. Subject preparation

The test should be undertaken in a quiet room.

The practitioner shall instruct the patient on each of the tests. Tuning fork tests are particularly subjective and response bias must be accounted for when determining their validity as diagnostic tools. Clear and concise instructions will limit misinterpretation by the patient.

When undertaking this test on young children it may be necessary to have the child sat on the parent's knee and the tuning fork should be held in plain sight. The practitioner may wish to prime the tuning fork and hold it on a surface so the sound can be heard to prepare the child for the test, it can also be helpful to get the child to close their eyes whilst they listen to help them concentrate.

4. The Tuning Fork Tests

The practitioner should start with the Weber test first as the results of this can influence missing a false Rinne negative.

4.1 The Weber Test

The Weber test is a test of lateralisation and establishes where a tone is perceived.

4.1.1 Procedure

Strike the tuning fork and place it on the midline, typically on the patient's forehead but it can also go on the vertex, bridge of the nose or chin. Place your other hand gently but firmly on the back of the patients head to ensure enough counter-pressure is applied. Hold the tuning fork in place for up to 4 seconds. (Figure 2).

4.1.2 Response

After giving the patient listening time ask them where the tone is heard: is it in both ears, centrally, in the head or towards the left or right.

Children may choose to point to the ear rather than giving a verbal response.

Figure 2 – Appropriate technique for the Weber test

4.1.3 Interpretation

1. With symmetrical hearing or a symmetrical hearing loss the sound should be central
2. With an asymmetrical sensorineural loss the sound should be heard in the better ear
3. With an asymmetrical conductive hearing loss the sound should be heard in the poorer ear

Points to note:

Thiagarajan & Arjunan (2012) suggest the Weber test can determine a difference of 5 decibels between each ear in terms of bone conduction thresholds at the frequency being tested.

This test can be complicated by the presence of a unilateral or asymmetrical conductive hearing loss, where the tone can be heard on the conductive side or the side with the greater conductive loss.

Interpretation of the Weber test in isolation can be prone to error.

4.2 The Rinne Test

This test is a comparison of loudness of perceived air conduction to bone conduction in one ear at a time.

4.2.1 Procedure

The practitioner should start with the ear which the Weber has lateralised to (if appropriate).

Strike the tuning fork and hold the tines of the tuning fork approximately 25mm from the ear canal entrance. The vibrating fork should be held parallel to the acoustic axis (see figure 1 and figure 3). The orientation of the tuning fork is critical so ensure the acoustic axis is pointing towards the ear canal.

Hold the tuning fork in position for about 2 seconds. (Figure 3). Next without any interruption and without touching the tines press the footplate firmly against the mastoid (without any hair getting between the footplate and the mastoid). Place your other hand gently, but firmly on the opposite side of the patients head to ensure enough counter-pressure is applied. Hold the tuning fork in place for another 2 seconds. (Figure 4).

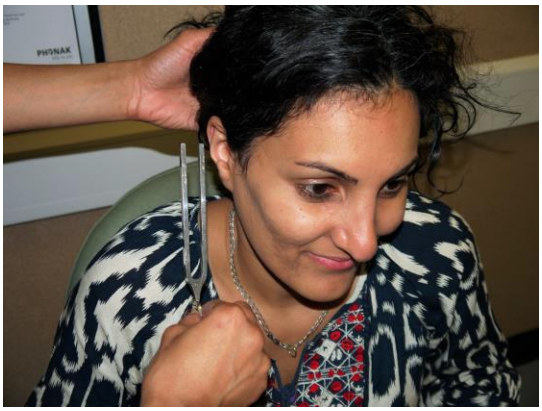

Figure 3 – Appropriate technique for the Rinne airconduction test

Figure 4 – Appropriate technique for the Rinnebone conduction test

4.2.2 Response

After giving the patient listening time, ask them whether the tone is louder next to the ear or behind the ear. The patient should respond verbally.

Children may choose to point to the ear rather than giving a verbal response.

4.2.3 Interpretation

1. If air conduction (next to the ear canal) is louder, this is a Rinne positive result indicating either normal hearing or a sensorineural hearing loss

2. If bone conduction (held on mastoid) is louder this is a Rinne negative result, indicating a significant conductive element to the hearing loss

The Rinne test is able to distinguish a conductive hearing loss with an air-bone gap of 17.5 dB - 30 dB (Jacob et al, 1993; Burkey et al, 1998). It therefore has limited use detecting mild conductive hearing losses or mixed hearing losses where there is an air-bone gap of less than 17.5dB.*

*The specificity and sensitivity of both the Rinne and Weber tests have been evaluated. The sensitivity of them is estimated at 76.86% and the specificity was projected to be 85.48%. (Bhat & Naseeruddin, 2004 & Boatman et al. 2007). A subsequent study found that when using the Weber test in isolation as a screening tool for sudden sensorineural hearing loss it's sensitivity was likely to be around 78% (Shuman, 2013). The tester should therefore be aware of probable errors through administering Tuning Fork tests, particularly in isolation, rather than as part of a battery of tests.

The tester should be aware that the Rinne test can result in a **False Rinne Negative.** This occurs when the bone conduction transmits through the skull to the opposite ear and is detected through cross hearing by the better cochlea (in the non-test ear). This occurs with a severe sensorineural loss predominantly on the test side. It can be distinguished through considering if the Weber test result is contradictory and through asking the patient which ear the bone conduction part of the test was heard in.

Masking of the non-test ear through the use of tragal rubbing can prevent cross hearing. The tester should place their index finger and thumb either side of the tragus and massage the outside of the tragus to create the masking noise. Please note this is not always efficient and is hard to interpret and it is recommended that if masking is required the patient should undergo a fully masked pure-tone audiogram.

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Appendix: Example test results

Please note that these interpretations are not precise and refer to tuning forks without masking. They must be supplemented by Pure Tone Audiometry with adequate masking wherever possible.

Example	Weber	Rinne		Interpretation
		Right	Left	
1	Central	+ve	+ve	Either: Bilateral normal Bilateral mainly symmetrical sensorineural
2	Left	+ve	-ve	Right normal or sensorineural Left conductive
3	Right	+ve	+ve	Normal or mainly sensorineural losses, probably greater on the left or with a slight conductive element on the right
4	Right	-ve	-ve	Bilateral conductive hearing losses, probably greater on the right but could also be sensorineural in the left (False Rinne negative)
5	Right	+ve	-ve	False Rinne negative due to a severe sensorineural or mixed hearing loss on the left and a relatively normal cochlea on the right
Please note with longstanding SNHL in one ear, the Weber response can be central and not lateralised				