False negative Rinne’s in unilateral conductive hearing loss

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ABSTRACT

Aims: It is accepted that Rinne’s test is negative in the same ear having a conductive hearing loss (CHL). It is also accepted that false negative Rinne’s occurs in the ear with severe sensorineural hearing loss (SNHL). However, we wanted to demonstrate the presence of false negative Rinne in unilateral CHL. Materials and Methods: Observational study with 13 patients with unilateral, moderate to severe CHL and ten patients with severe to profound SNHL of 40db-115 db in the frequency range of 250/500/1000 Hz. Results: The patients with CHL demonstrated a false negative Rinne on the better hearing ear at a minimum threshold of 50 dB while patients with SNHL demonstrated false negative Rinne on the worse hearing ear with a minimum threshold of 70 dB. Conclusions: Based on our observation, false negative Rinne can occur in patients with conductive hearing loss and this phenomenon needs to have a different name.

KEYWORDS: Conductive hearing loss, False negative rinne, Tuning fork

INTRODUCTION

When a patient approaches us with a hearing problem, a thorough assessment is required to establish the side, site, cause, and severity of the impairment. In our clinics, we would normally include the tuning fork tests in our battery of investigations.

John Shore, a musician to King James II of England invented the tuning fork in 1711. However, clinical use of a tuning fork was only evident when Ernst Weber published his description of the Weber’s test in 1825 and later in 1885, Heinrich Rinne published his series of 22 test comparing air from bone conduction and this resulted in the Rinne test.[1]

The Rinne test is conducted with a 512Hz tuning fork and is alternately placed on the mastoid and at the ear. A positive Rinne occurs when air conduction is perceived louder than bone conduction. This is seen in normal listeners or patients with sensorineural hearing loss (SNHL). Conversely, when a sound is heard louder from the mastoid, this is a negative Rinne test and is indicative of a conductive hearing loss (CHL).[2]

Then there is the false negative Rinne. This occurs when bone conduction on the profoundly deaf ear is perceived louder than the air conduction but the sound has actually travelled via the bone and is picked up by the cochlea of the good ear. Masking with a Barany noise box of the non-test ear (better hearing ear) will expose this false-negative.[2] Although there is no published data that documents the hearing threshold for a false negative Rinne to occur, it is still an accepted fact that it is only seen in SNHL.

Contrary to what is known and ingrained in our belief system, we have found that false negative Rinne can occur in patients with CHL. We label this as false negative Rinne for a few reasons. For one, this sign is elicited from the normal ear and secondly, the patient indicates that it is not heard from the ear with the tuning fork but instead from the side with the hearing impairment.

MATERIALS AND METHODS

Over a period of one year, we have observed countless cases of such false negative Rinne in CHL. However, to ensure that...
there were other confounding factors, we specifically studied patients who had purely unilateral CHL as well as purely SNHL. There were thirteen patients with unilateral, moderate to severe CHL and ten patients with severe to profound SNHL who exhibited the classic *false negative Rinne*. The hearing loss from these 23 patients fell in the frequency range of 125/500/1000 Hz. The room in which the tuning fork test was conducted had an ambient noise of 65 dB (tested by sound level meter). The tuning fork in the Rinne test used was 512 Hz.

We paid special attention to the 500Hz in the pure tone audiometry as we were interested in comparing it with the tuning fork test. Otosclerosis, chronic otitis media and cholesteatoma made up the bulk of our CHL diagnosis with a hearing loss ranging from 50 dB to 75 dB whereas our patients with SNHL had the best hearing threshold of 70 dB to 115 dB. All the patients in the CHL had Weber's lateralizing to the worse ear and in the SNHL group had lateralized to the better ear.

**RESULTS**

We concluded that patients with SNHL of less than 70 dB at the frequency of 500Hz, *false negative Rinne* could not be demonstrated. However, *false negative Rinne* was present in patients with CHL as low as 50 dB at the same frequency.

We hypothesize that the *false negative Rinne* in CHL is relatable to the Weber's test. To understand this, we need to understand what happens in Weber's test. Sound is lateralized towards the ear with the conductive loss as the sound intensity that reaches the cochlea is greater in the affected ear. Numerous theories have been published to help explain this occurrence but there are two popular ones. First is the loss of masking by environmental sound which is resulted by the conductive loss but there are two popular ones. First is the loss of masking by environmental sound which is resulted by the conductive loss and the second is the absence of “leakage” of sounds which is prevented by the vibration of the ossicular chain towards the external ear canal. Some argue that it is a combination of both theories.[3]

Weber's test is assessed by placing a tuning fork on the midline (vertex, chin or incisor teeth). This gives equidistance between the both ears. Should we inch this tuning fork slowly away from the midline and away from the affected ear, the ear with the CHL should still perceive it louder based on the reasoning behind the Weber's test. We believe that if the CHL is severe enough, we will be able to move the tuning fork until it reaches the mastoid tip of the good ear (as if we were conducting a Rinne's test).

In the case of the SNHL, lateralization goes to the better hearing ear and this occurs because sound is now perceived by the only good cochlear unlike the enhanced hearing in the CHL. This is enforced by our findings of the hearing threshold required before the *false negative Rinne* is present. Patients with SNHL required a lower hearing threshold of at least 70 dB whereas the CHL group required a hearing threshold of only 50 dB. The smaller threshold required by the CHL cochlea is likely to be due to the enhanced performance of the cochlea with the loss of masking and leakage of sounds.

We documented that majority of the patients (from both the conductive as well as sensorineural hearing loss) only claimed that it was heard louder from the mastoid but neglect to mention the side. Hence it is suggested that the patient is asked which ear the sound is heard when the tuning is placed on the mastoid. This way it may clarify the side of the hearing loss as well as determine if masking is required.

We wonder why this phenomenon of *false negative Rinne* in CHL has not been reported before. Is it possible that tuning fork tests are losing their place in our clinics and are neglected with the advancement in the world of audiology? Undeniably, Rinne test has a low sensitivity[4] and with the availability of pure tone audiometer that provides a broader picture, it is understandable that tuning fork tests are less utilised. However, we find that tuning fork tests are still useful in the clinics while waiting for an audiological assessment.

We are aware that our sample size is small and therefore these are only our preliminary findings. We are excited about the outcome so far and it is an ongoing study to help increase our sample size and study its statistical significance. Meanwhile, we find this new side of *false negative Rinne* intriguing and needs to have a different name. We suggest *true false negative Rinne* occurring in unilateral SNHL and a *false negative Rinne* in CHL.

**CONCLUSION**

In conclusion, the *false negative Rinne* occurs not only in same side of SNHL but also to the normal ear of patients with unilateral CHL.

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**REFERENCES**


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