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CONTINUED

# Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

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CONTINUED

Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

Learner Outcomes: *As a result of this Continuing Education Activity, participants will be able to …*

1)List 4 common errors in the clinical measurement of aural immittance

2)Identify the importance of young age in selecting an appropriate probe tone

3)List 3 under-utilized clinical applications of acoustic reflexes



CONTINUED™

## Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

- **Introduction and historical perspective (0 – 5 minutes)**
- **Review of common errors in single frequency tympanometry and analysis (6 – 20 minutes)**
- **Consequences of inappropriate probe tone frequency in young children (21 – 30 minutes)**
- **Review of common errors or deficiencies in acoustic reflex measurement and analysis (31 – 45 minutes)**
- **Rarely applied yet clinically valuable acoustic reflex measurements (46-54)**
- **Questions and answers (55 – 60 minutes)**



## Common Errors in Aural Immittance Measurement: Historical Perspective *Otto Metz (1905-1995)*

## Common Errors in Aural Immittance Measurement:
*Historical Perspective*
Otto Metz (1903-1995)

"In October 1943, just as the Nazis were preparing to intern all Jews in Denmark, Otto Metz had the good fortune to be one of the more than 6,000 Jews spirited across the sea to Sweden by the Danish Resistance. Thus escaping capture, Metz was able to continue his pioneering research at the University Hospital of Lund.

After returning safely to Copenhagen in 1945, Metz formulated the basic principles of tympanometry in his dissertation of 1946: "The acoustic impedance measured on normal and pathological ears". This constituted the earliest substantial set of acoustic impedance measurements in normal and pathological ears – and obtained using a mechanical bridge.

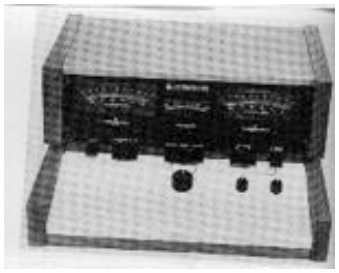
Continuing this work at Rigshospitalet, Metz also published the seminal "Threshold of reflex contractions of muscles in the middle ear and recruitment of loudness" in the Archives of Otolaryngology in 1952. This was the first study of the acoustic stapedius reflex in patients with ear disease." (GN Otometrics Website)

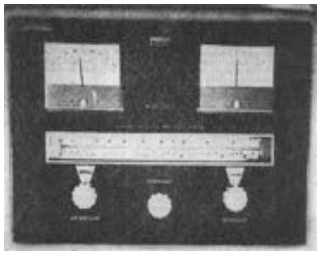


## Historical Perspective:
## Scott-Nielsen and Terkildsen
## With Madsen ZO61 Impedance Bridge

## James Jerger

**Classic Impedance Studies in Early 1970s at Methodist Hospital And Baylor College of Medicine in Houston Texas, USA**





Clinical Experience With
Impedance Audiometry

James Jerger, PhD, Houston

Impedance audiometry was performed as part of the routine clinical examination in a consecutive series of more than 400 patients with various types and degrees of hearing impairment. An electroacoustic bridge (Madsen, ZO 70) was used to carry out the measurement of tympanometry, acoustic impedance, and threshold for the acoustic reflex. Results indicate that, while individual components of the total impedance battery lack diagnostic precision, the overall pattern of results yielded by the complete battery can be of great diagnostic value, especially in the evaluation of young children.

THE development of impedance audiometry during the past decade has added new scope and dimension to clinical audiology. Based on the pioneering efforts of Metz,[1] subsequent workers have refined instrumentation, technique, and interpretation to produce an invaluable tool for differential diagnosis.

The development of contemporary instrumentation for impedance audiometry has, in the main, followed two essentially parallel paths. In the United States, Zwislocki and his colleagues[2-4] developed an electromechanical bridge. In Europe, Theorell, Terkildsen, Møller, and others,[5-10] pioneered the application of the electroacoustic approach, culminating in the present commercially available electroacoustic bridge.

The present paper reports our clinical experience with the latter instrument based on its routine administration to well over 400 successive patients over a one-year period. Our aim was to assess the efficacy of the electroacoustic approach as a routine clinical procedure and to evaluate its diagnostic value in a typical audiologic case load.

In general we found that the testing procedure was easily mastered, even by audiologically unsophisticated personnel, that valid and meaningful results could be obtained for almost every patient, and that, with certain reservations, the data of impedance audiometry constitute extremely valuable diagnostic information.

Subsequent sections present statistical information when patients are grouped according to age and type of hearing loss, and individual case reports illustrating the diagnostic value of impedance audiometry.

Method

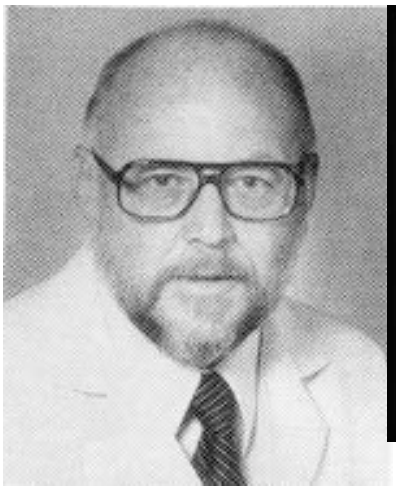
Apparatus.—Impedance audiometry was carried out by means of an electroacoustic impedance bridge (Madsen, type ZO 70) and an associated pure-tone audiometer (Maico, type 101). Figure 1 shows a schematic diagram of the principal components of the impedance bridge.

A probe tip containing three tubes is sealed in the external meatus, forming a closed cavity bounded by the inner surface of the probe tip, the walls of the external meatus, and the tympanic membrane. One tube is used to deliver, into this closed cavity, a probe tone generated by a 220-kcps oscillator driving a miniature receiver. The second tube is connected to a miniature probe microphone which monitors the sound pressure level of the 220-Hz probe tone in the closed cavity and delivers the transduced voltage through an amplifier to a bridge circuit and balance meter. The balance meter is nulled by an SPL of exactly 85 dB in the closed cavity. A potentiometer on the output of the 220-Hz oscillator permits variation of the SPL over a range corresponding to a compliance variation (equivalent volume) of 0.2 to 5.0 cc. The third tube is connected to an aneroid which permits variation in air pressure in the closed cavity over a range of 0-400 mm (water). Air pressure is read on an electromanometer.



## James Jerger

**Classic Impedance Studies in Early 1970s at Methodist Hospital And Baylor College of Medicine in Houston Texas, USA**



**James Hall with Larry Mauldin (circa 1975)**

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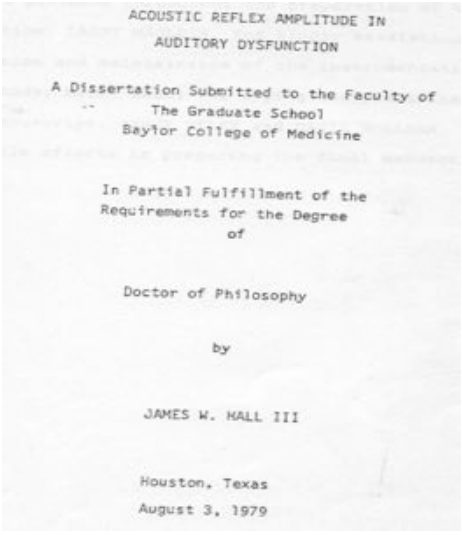
Acoustic Reflex Amplitude in Auditory Dysfunction
*Dissertation: James W. Hall III, 1979*



ACOUSTIC REFLEX AMPLITUDE IN
AUDITORY DYSFUNCTION

A Dissertation Submitted to the Faculty of
The Graduate School
Baylor College of Medicine

In Partial Fulfillment of the
Requirements for the Degree
of

Doctor of Philosophy

by

JAMES W. HALL III

Houston, Texas
August 3, 1979



CONTINUED

Published Articles Based on PhD Dissertation

- Hall JW III. Acoustic reflex amplitude: I. Effect of age and sex. *Audiology (Basel) 21:* 294-309, 1982
- Hall JW III. Acoustic reflex amplitude: II. Effect of age-related auditory dysfunction. *Audiology (Basel) 21:* 386-399, 1982
- Hall JW III. Quantification of the relationship between crossed and uncrossed acoustic reflex amplitude. *Ear and Hearing 3:* 296-300, 1982



CONTINUED™

## Additional Published Articles on Impedance/Immittance Measures

- Hall JW III and Bleakney ME. Hearing loss prediction by the acoustic reflex: Comparison of seven methods. *Ear and Hearing 2:* 156-164, 1981
- Hall JW III. Hearing loss prediction in a young population: Comparison of seven methods. *International Journal of Pediatric Otorhinolaryngology 3*: 225-243, 1981
- Hall JW III and Koval C. Accuracy of hearing prediction by the acoustic reflex. *The Laryngoscope 92*: 140-149, 1982
- Hall JW III, Berry GA and Olson K. Identification of serious hearing loss with acoustic reflex data: Clinical experience with some new guidelines. Scandinavian Audiology 11: 251-255, 1982
- Hall JW III. The effects of high-dose barbiturates on the acoustic reflex and auditory evoked responses: Two case reports. *Acta Otolaryngologica (Stockholm) 100*: 387-398, 1985



## Common Errors in Aural Immittance Measurement:

## *Definitions*

- Immittance = impedance + admittance
- Impedance ($Z_a$) = opposition to acoustic energy flow through middle ear system (in acoustic ohms)
- Admittance ($Y_a$) = ease of acoustic energy flow through middle ear system (in acoustic mmhos); reciprocal of $Z_a$

## Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

- Introduction and historical perspective (0 – 5 minutes)
- Review of common errors in single frequency tympanometry and analysis (6 – 20 minutes)
- Consequences of inappropriate probe tone frequency in young children (21 – 30 minutes)
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- Rarely applied yet clinically valuable acoustic reflex measurements (46-54)
- Questions and answers (55 – 60 minutes)



## Common Errors in Aural Immittance Measurement: *Review of Common Errors in Single Frequency Tympanometry and Analysis*

- Equipment not calibrated at the beginning of clinical day
- No otoscopic inspection before inserting probe
- Use of excessively slow pump speed for tympanometry in young children
- Selecting negative to positive pressure change versus vice versa
- Reporting an invalid Type B tympanogram
- Failure to perform diagnostically useful tests involving tympanometry
- Forgetting that tympanometry is NOT a test of hearing

## Common Errors in Aural Immittance Measurement: *Calibration*

British Society of Audiology
KNOWLEDGE | LEARNING | PRACTICE | IMPACT

**Recommended Procedure**

**Tympanometry**

Date of version: August 2013
Date for review: August 2018

- Introduction
- General considerations
- Equipment
- Calibration
- Subject preparation
- Test procedure
- Results and reporting
- References
- Appendices
  - Authors and acknowledgements
  - Definitions and units
  - Effects of sweep speed and direction



## Common Errors in Aural Immittance Measurement: *Calibration*

- Daily calibration in hard-walled cavities
- Daily biological verification with a known normal ”golden” ear
- Biological check anytime unexpected findings are encountered clinically
- Periodical inspection and cleaning of probe assembly ports and tubes

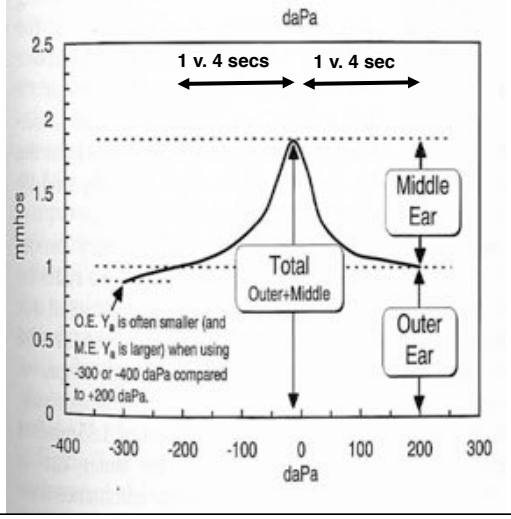
| Cavity | Acceptable value |
|---|---|
| 0.5 $cm^3$ | 0.5 $cm^3$ |
| 2.0 $cm^3$ | 1.9–2.1 $cm^3$ |
| 5.0 $cm^3$ | 4.8–5.2 $cm^3$ |

## Common Errors in Aural Immittance Measurement:
*No Otoscopic Inspection Before Inserting Probe*

- Complete otoscopic inspection *before* aural immittance measurement
- Immittance measures are recorded in the external ear canal
- Immittance may be affected or compromised by:
  - Cerumen
  - Vernix
  - Debris
  - Foreign objects

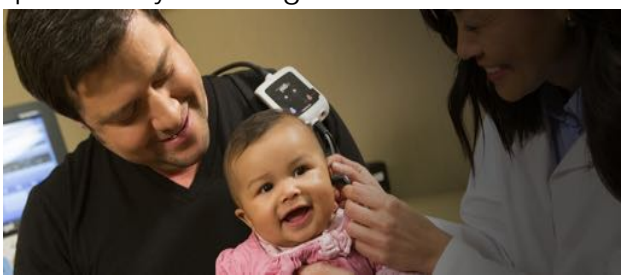


## Use of Excessively Slow Pump Speed for Tympanometry in Young Children i.e., 50 daPa vs. 200 daPa per Second




- Pump speed options (daPa/sec)
  - 12.5
  - 50
  - 200
  - 600

## Take Advantage of New Features of Modern Equipment
for Tympanometry in Young Children



### Auto Start is here

As soon as a seal is obtained in the ear, the sweep begins without any need to press buttons to save time with challenging patients.

- Screen touch technology
- Programmable user tests
- Test type buttons

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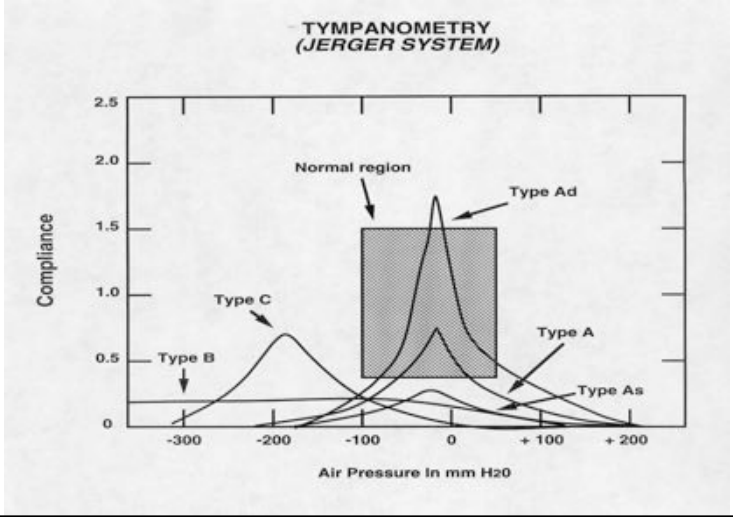
## A Simple System for Categorizing Tympanograms

**Jerger J (1970). Clinical experience with impedance audiometry. *Arch Otolaryngology, 92*, 311-324**

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Tympanogram Type as a Function of Pressure Change Direction in 186 Ears (Hall & Chandler, 1994)
"Ear Hysteresis … Shift of 20 daPa in Pressure Direction"

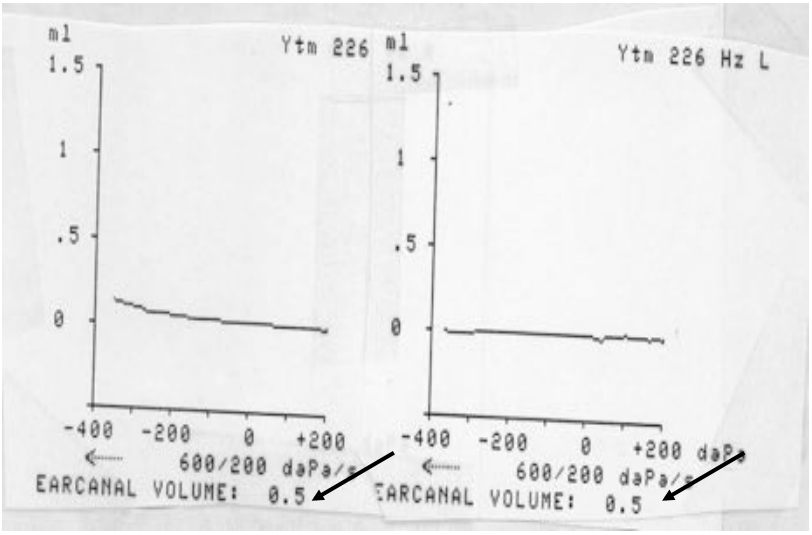
| Descending Pressure (+ to -) | | Ascending Pressure (- to +) A | As | Ad | B | C | Cpos |
|---|---|---|---|---|---|---|---|
| A | 123 | 0 | 4 | 0 | 7 | 0 | |
| As | | 7 | 4 | 0 | 0 | 0 | 0 |
| Ad | | 1 | 0 | 4 | 0 | 0 | 0 |
| B | 0 | 0 | 0 | 2 | 0 | 0 | |
| C | 4 | 0 | 0 | 0 | 17 | 0 | |
| Cpos | | 0 | 0 | 0 | 0 | 0 | 6 |



## Common Errors in Aural Immittance Measurement:
*Reporting an Invalid Type B Tympanogram …*
*Explanations for a Spurious Flat Tympanogram*

- Opening in the tympanic membrane
  - Perforation
  - Ventilation tube (grommet)
- Occlusion of probe tip by sharp turn in ear canal wall
- External ear canal impacted by cerumen (e.g., in an elderly patient with "sudden" presbycusis
- Blockage of one or more probe tubes
  - Manometer tube (for changing air pressure)
  - Loudspeaker tube (for delivering probe tone)
  - Microphone tube (for detecting admittance change)
- Faulty transducer producing probe tone (*Daily calibration is important!)*

## Common Errors in Aural Immittance Measurement:
## *Valid Type B Tympanogram in a Child with Otitis Media*

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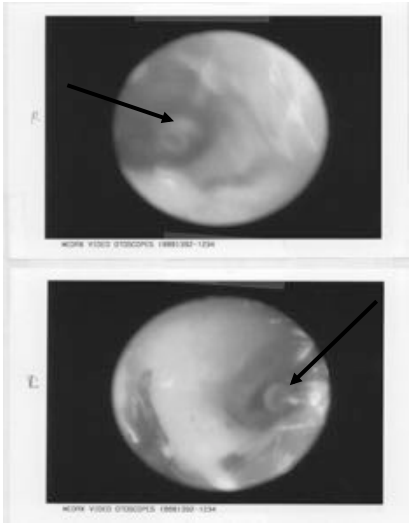
## Common Errors in Aural Immittance Measurement:
## *Reporting an Invalid Type B Tympanogram …*
## *Patent Ventilation Tubes*



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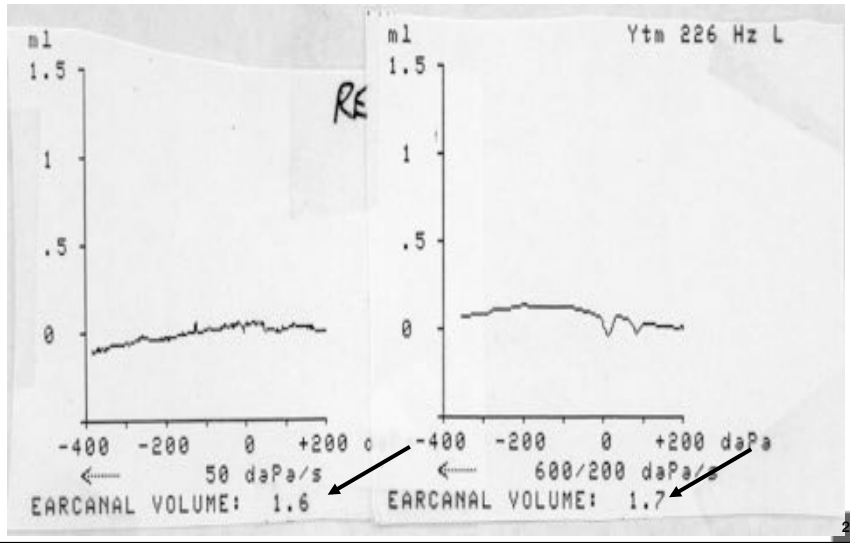
## Common Errors in Aural Immittance Measurement:

***Invalid Flat Tympanogram in the Same Child with Ventilation Tubes***

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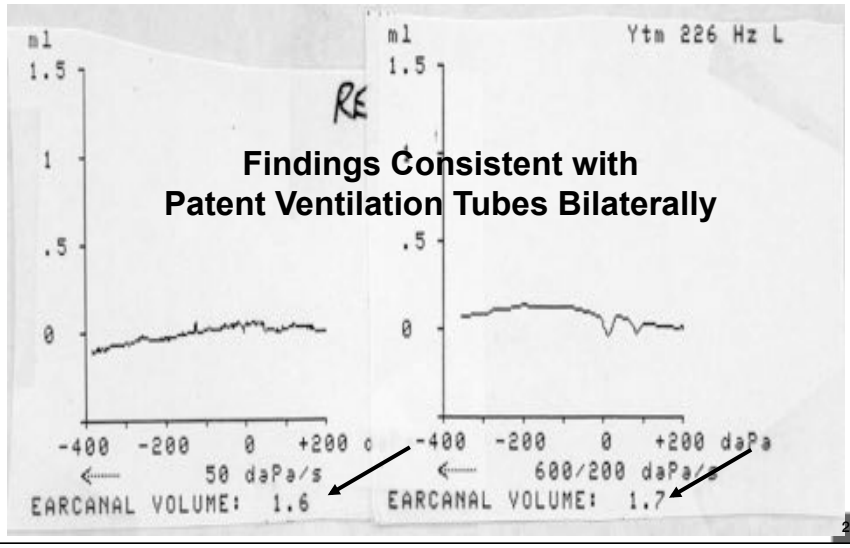
## Common Errors in Aural Immittance Measurement:

***Invalid Flat Tympanogram in the Same Child with Ventilation Tubes***




**Findings Consistent with Patent Ventilation Tubes Bilaterally**

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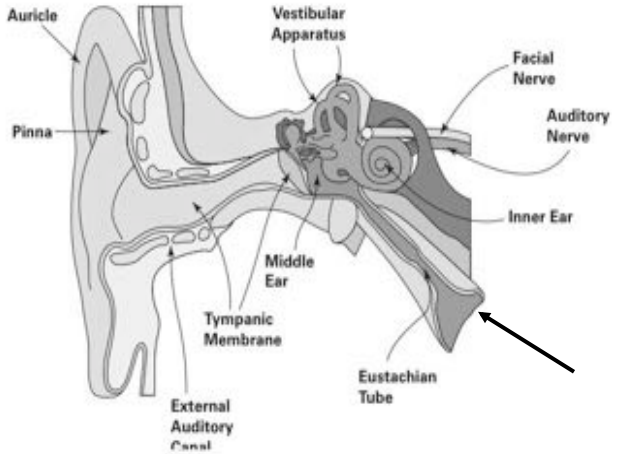
## Common Errors in Aural Immittance Measurement: *Failure to Perform Diagnostically Useful Tests Involving Tympanometry … Eustachian Tube Function*

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## Assorted Applications of Admittance Measurement: Assessment of Eustachian Tube (ET) Dysfunction

- Anatomy of ET
  - Connects nasopharynx to middle ear cavity
  - Approximately 30 to 40 mm in length
  - One third bone and 2/3 cartilage
  - Lined with mucous
- Differences in ET for young children versus adults
  - ET in young children is:
    - Shorter
    - Oriented more horizontally
    - Mostly cartilage
    - More lubricated
    - Smaller lumen
  - ET matures at about 7 years

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## Assorted Applications of Admittance Measurement: Assessment of Eustachian Tube Dysfunction

- Function of ET
  - Pumping action of cilia lining the ET contributes to clearance of secretions from middle ear into the nasopharynx
  - Protects middle ear from nasal and pharyngeal secretions
  - Minimizes sound (vocalization) that reaches ear
  - Equalizing pressure between middle ear space and outside
    - Mucous lining of middle ear space absorbs oxygen
    - Air from mouth via ET replaces oxygen in middle ear



## Assorted Applications of Admittance Measurement: Assessment of Eustachian Tube Dysfunction

- Opening of the ET
  - Active opening
    - Swallowing (8 muscles are involved with veli palatini most important)
    - Yawning
    - Jaw movements
    - Poorer in children than in adults
  - Passive opening
    - Pressure gradient between nasopharynx and middle ear space (from higher to lower pressure) is exceeded and air passes through the ET
    - Common in children

## Assorted Applications of Admittance Measurement: Assessment of Eustachian Tube Dysfunction

- Types of ET Dysfunction
  - Obstruction
    - Mechanical blockage due to mucosal edema secondary to allergy, URI, large adenoids
    - Inflammation in suppurative otitis media
    - Distention of ET walls due to soft cartilage (young children)
  - Patency (patulous or open ET). Patient may hear:
    - Own voice loudly
    - Rushing sound associated with breathing



## Assorted Applications of Admittance Measurement: 1. Assessment of Eustachian Tube Dysfunction with Intact TM

- Inflation-Deflation Test
  - Record baseline tympanogram
  - Create high positive or negative pressure in the external ear canal (e.g. 400 daPa or -400 daPa)
  - Patient swallows several times
  - Tympanogram is repeated
  - Small shift in tympanogram peak(away from applied pressure) suggests normal ET function

## Assorted Applications of Admittance Measurement: 2. Assessment of Eustachian Tube Dysfunction with Intact TM

- Valsalva Procedure
  - Named after Antonio Maria Valsalva, a 17th century Italian physician and anatomist
  - Record baseline tympanogram
  - Patient pinches nose while attempting to exhale through the nose to inflate the nasopharynx
  - Tympanogram is repeated during Valsalva maneuver
  - Clear positive shift in tympanogram peak is observed if procedure is successful



## Assorted Applications of Admittance Measurement: 3. Assessment of Eustachian Tube Dysfunction with Intact TM

- Toynbee Procedure
  - Named after Joseph Toynbee, a 19th century British otologist
  - Record baseline tympanogram
  - Patient pinches nose while swallowing water
  - Tympanogram is repeated after Toynbee maneuver
  - Clear negative shift in tympanogram peak is observed if procedure is successful, indicating ET functioning

## Common Errors in Aural Immittance Measurement: *Forgetting that Tympanometry is NOT a Test of Hearing*

- Tympanometry is a measure of input impedance or admittance of the middle ear system
- The amount of energy flowing into system is known but not how much energy is transmitted through the system
- Tympanogram types do not always correlate with hearing
  - Very abnormal hyper-compliant $A_d$ tympanogram (e.g., monomeric TM) yet normal hearing sensitivity
  - Normal, perhaps shallow ($A_s$), tympanogram with significant conductive hearing loss (e.g., otosclerosis
  - Normal (Type A) tympanogram in a patient with dead ear
- Tympanometry provides no information on most of the auditory system … from the cochlea to the cortex



## Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

- Introduction and historical perspective (0 – 5 minutes)
- Review of common errors in single frequency tympanometry and analysis (6 – 20 minutes)
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- Questions and answers (55 – 60 minutes)

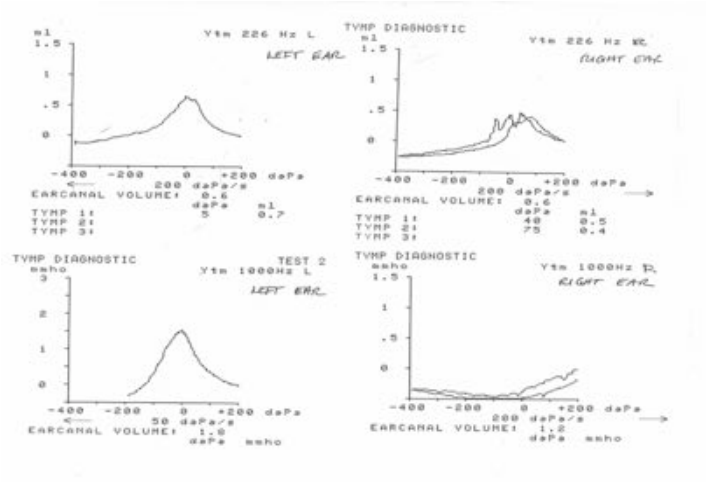
Diagnosis of Hearing Loss: Protocol for Confirmation of Hearing Loss in Infants and Toddlers (0 to 6 months)

*Year 2007 JCIH Position Statement*

- Child and family history
- Otoacoustic emissions
- ABR during initial evaluation to confirm type, degree & configuration of hearing loss
- Acoustic immittance measures (including acoustic reflexes) *using high frequency (1000 Hz) probe tone*
- Supplemental procedures (insufficient evidence to use of procedures as "sole measure of auditory status in newborn and infant populations")
  - Auditory steady state response (ASSR)
  - Acoustic middle ear reflexes for infants < 4 months
  - Broad band reflectance
- Behavioral response audiometry *(if feasible)*
- Parental report of auditory & visual behaviors
- Screening of infant's communication milestones



## Low (226 Hz) versus High (1000 Hz) Probe Tone for Infant Tympanometry



## Tympanometry in Infants and Young Children: Clinical Recommendations and Cautions

- The middle ear system of a newborn infant is mass dominated with a lower resonant frequency (Kei et al, 2007)
- The adult middle ear system is stiffness dominated with a higher resonance frequency
- External ear canals of neonates "are distensible under applied air pressure because of the underdeveloped osseous portion of the ear canal" (Kei et al, 2007)
- "Compensating for the ear canal contribution by making measurements of admittance at extreme ear canal static pressures (I.e., +200 or - 400 daPa) may introduce errors in estimating the static admittance." (Kei et al, 2007)
- Use a 1000 Hz probe tone for tympanometry with infants up to the chronological age of at least 4 months
- Calculate ear canal volume with a 226 Hz probe tone
- Ear canal volume measurements at extreme positive or negative pressures may not be accurate in neonates.

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## Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

- Introduction and historical perspective (0 – 5 minutes)
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- Questions and answers (55 – 60 minutes)

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## Common Errors in Aural Immittance Measurement:
### *Review of Common Errors or Deficiencies in Acoustic Reflex Measurement and Analysis*

- No attempt to record acoustic reflexes in most patients
- Limited knowledge of acoustic reflex pathways
- Acoustic reflex recording in only ipsilateral condition
- Reliance on pure tone stimulus for acoustic reflex measurement rather than a BBN stimulus
- Inadequate appreciation for diagnostic value of acoustic reflex measurement in various patient populations, including newborn infants *... next topic*



## Common Errors in Aural Immittance Measurement:
### *Many Audiologists Do Not Record Acoustic Reflexes in Most Patients*

**Martin FN et al (1998). Seventh survey of audiometric practices in the United States. *JAAA, 9,* 95-104**

**Table 4 Immittance Measures Routinely Obtained (n = 203)**

| *Response* | *1992 (%)* | *1997 (%)* |
|---|---|---|
| Static compliance | 58 | 51 |
| Absolute impedance | — | 16 |
| Otoadmittance | 17 | 11 |
| Tympanometry | 96 | 96 |
| Contralateral acoustic reflex | 89 | 81 |
| Ipsilateral acoustic reflex | 89 | 87 |
| Acoustic reflex decay | 73 | 62 |
| SPAR | 8 | 5 |
| Multifrequency tympanometry | 10 | 8 |
| Other | | <1 |

## Common Errors in Aural Immittance Measurement:

*Many Audiologists Do Not Record Acoustic Reflexes in Most Patients*

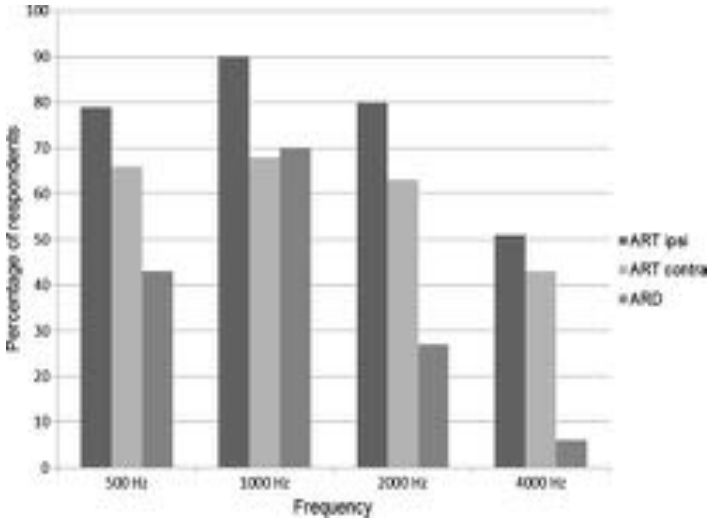
- Emanuel et al (2012). Survey of audiological immittance practices. *AJA, 21,* 60-85
  - Survey responses from 156 audiologists (2008 + 2009)
  - Decrease in contralateral acoustic reflex testing over time
  - Patient discomfort reportedly common
- Emanuel DC et al (2011). Survey of diagnosis and management of auditory processing disorder. AJA, 20, 48-60
  - Survey responses from 192 audiologists who perform APD assessments
  - >90% of audiologists evaluate APD in children
  - 69% of audiologists perform acoustic reflex threshold measurements vs. 97% who perform tympanometry



## Common Errors in Aural Immittance Measurement:

*Many Audiologists Do Not Record Acoustic Reflexes in Most Patients*

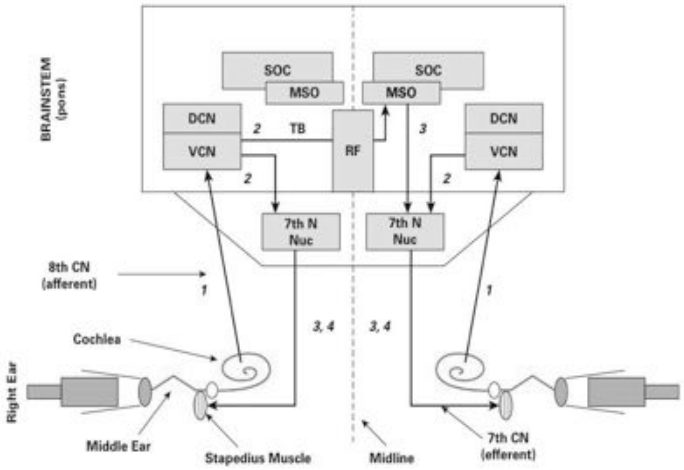
Emanuel et al (2012)



## Limited Knowledge of Acoustic Reflex Pathways

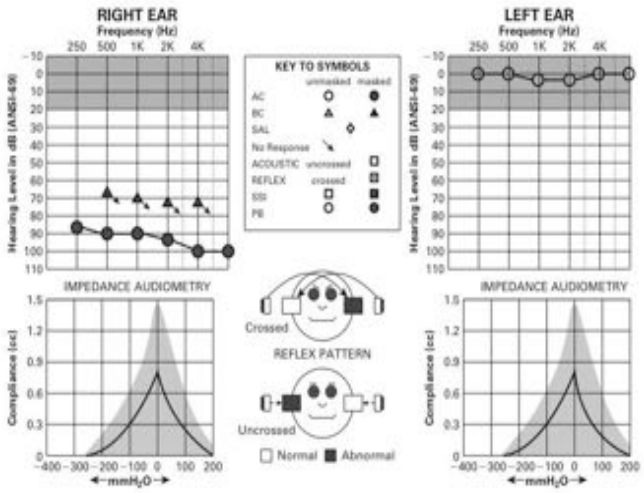
**Acoustic Stapedial Reflex Pathways According to Erick Borg**

**(From Hall JW III (2014). *Introduction to Audiology Today*. Boston: Pearson)**






## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*



## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*

☐ **Abnormal Acoustic Reflex**

Acoustic reflex patterns (“faces”)

- Conductive/efferent pattern
- Sensory pattern
- Neural pattern
- Brainstem pattern

| | Right | Left |
|---|---|---|
| **Crossed (contralateral) Defined by Sound in Ear** | ☐ | ☐ |
| **Uncrossed (ipsilateral) Probe and sound in ear** | ☐ | ☐ |

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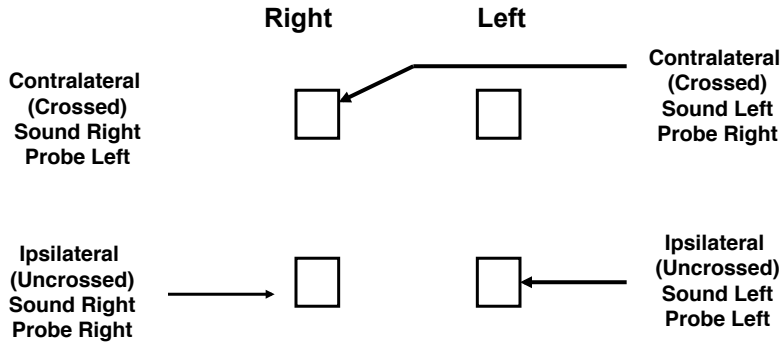
## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*

☐ **Abnormal Acoustic Reflex**

**Vertical pattern: Mild conductive hearing loss pattern or efferent (7th CN) pattern (normal tymp and no air bone gap) on right ear**

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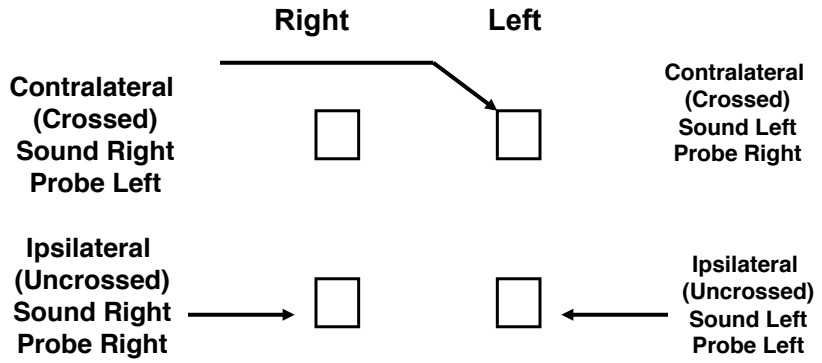
## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*

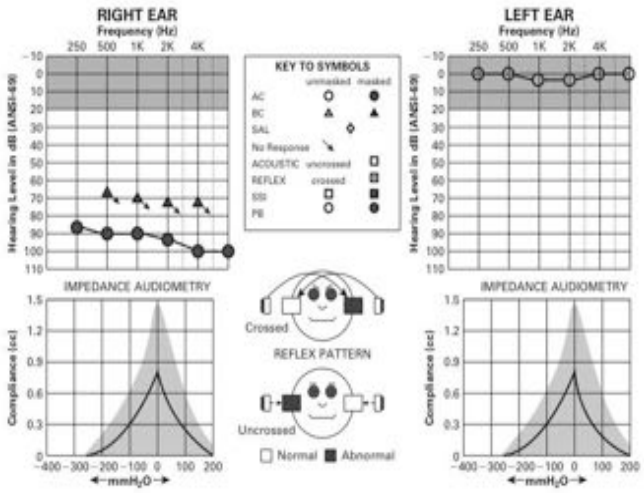
Abnormal Acoustic Reflex

**Diagonal pattern: Severe sensory hearing loss or 8th nerve auditory dysfunction on right ear**





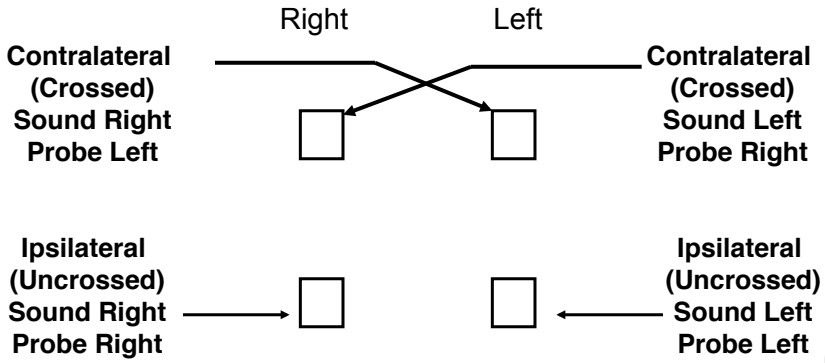

## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*



## Common Errors in Aural Immittance Measurement: *Acoustic Reflex Recording Only in Ipsilateral Condition*

☐ **Abnormal Acoustic Reflex**

Horizontal pattern: Brainstem auditory dysfunction

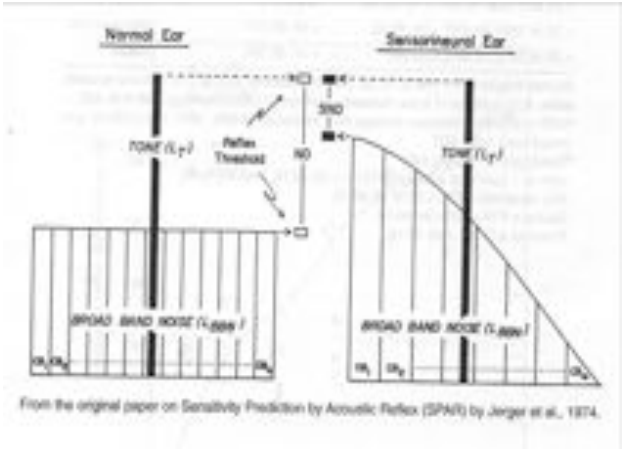





## Common Errors in Aural Immittance Measurement: *Reliance on Pure Tone Stimulus for Acoustic Reflex Measurement Rather Than a BBN Stimulus*

- **No attempt to record acoustic reflexes in most patients**
- **Limited knowledge of acoustic reflex pathways**
- **Acoustic reflex recording in only ipsilateral condition**
- **Reliance on pure tone stimulus for acoustic reflex measurement rather than a BBN stimulus**
- **Inadequate appreciation for diagnostic value of acoustic reflex measurement in various patient populations, including newborn infants** … ***next topic***

**Common Errors in Aural Immittance Measurement:**
***Reliance on Pure Tone Stimulus Only for Acoustic Reflex Measurement Rather Than a BBN Stimulus***



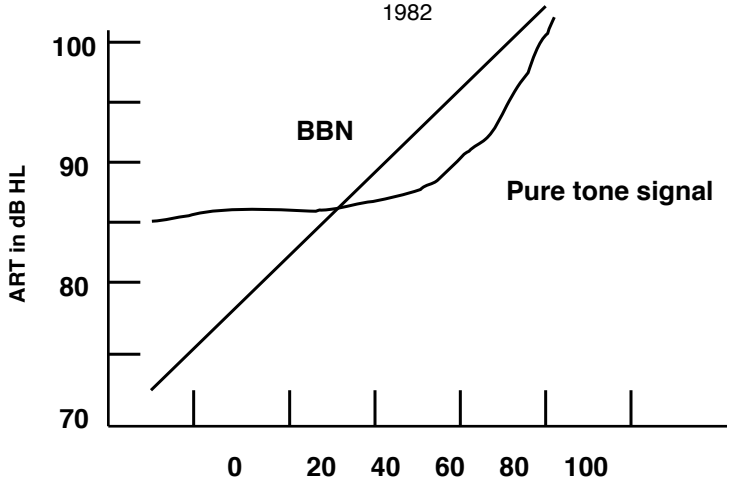

From the original paper on Sensitivity Prediction by Acoustic Reflex (SPAR) by Jerger et al., 1974.

Jerger J, Burney P, Mauldin L & Crump B (1974).
Predicting hearing loss from the acoustic reflex. *JSHD, 39,* 11-22



**Simplified SPAR (Sensitivity Prediction by the Acoustic Reflex)**

Hall JW III, Berry GA and Olson K. Identification of serious hearing loss with acoustic reflex data: Clinical experience with some new guidelines. Scandinavian Audiology 11: 251-255, 1982

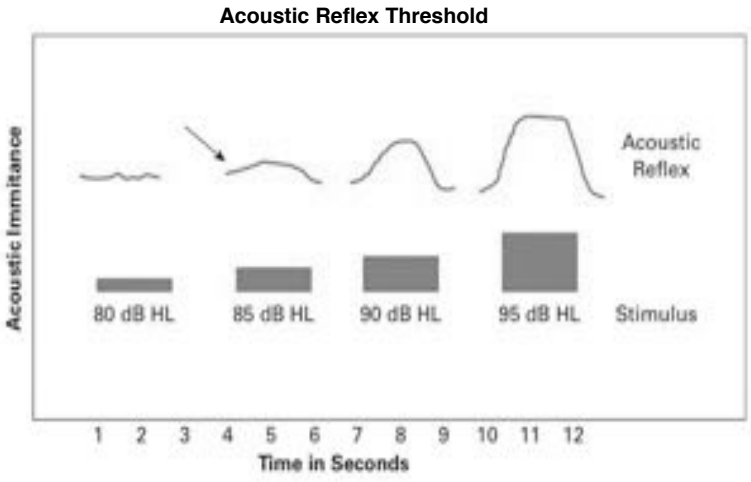


## Common Errors in Aural Immittance Measurement: Tympanometry and Acoustic Reflexes

- Introduction and historical perspective (0 – 5 minutes)
- Review of common errors in single frequency tympanometry and analysis (6 – 20 minutes)
- Consequences of inappropriate probe tone frequency in young children (21 – 30 minutes)
- Review of common errors or deficiencies in acoustic reflex measurement and analysis (31 – 45 minutes)
- Rarely applied yet clinically valuable acoustic reflex measurements (46-54)
- Questions and answers (55 – 60 minutes)



## Common Errors in Aural Immittance Measurement: *Rarely Applied Yet Clinically Valuable Acoustic Reflex Measurements*



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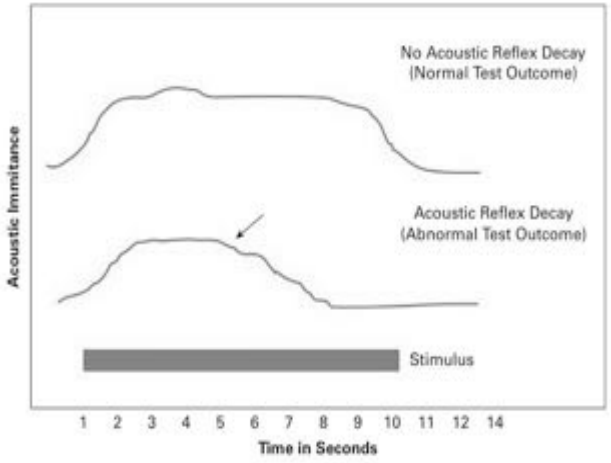
## Common Errors in Aural Immittance Measurement:
*Rarely Applied Yet Clinically Valuable Acoustic Reflex Measurements*

**Acoustic Reflex Decay**



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## Common Errors in Aural Immittance Measurement:
*Rarely Applied Yet Clinically Valuable Acoustic Reflex Measurements*

**Acoustic Reflex Amplitude**

ACOUSTIC REFLEX AMPLITUDE IN
AUDITORY DYSFUNCTION

A Dissertation Submitted to the Faculty of
The Graduate School
Baylor College of Medicine

In Partial Fulfillment of the
Requirements for the Degree
of

Doctor of Philosophy

by

JAMES W. HALL III

Houston, Texas
August 3, 1979

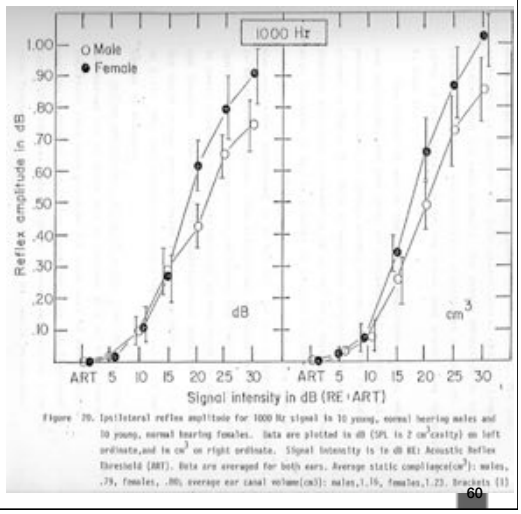


Figure 20. Ipsilateral reflex amplitude for 1000 Hz signal in 10 young, normal hearing males and 10 young, normal hearing females. Data are plotted in dB (SPL re 2 cm3 cavity) on left ordinate, and in cm3 on right ordinate. Signal intensity is re dB RE: Acoustic Reflex Threshold (ART). Data are averaged for both ears. Average static compliance(cm3): males, .79, females, .80; average ear canal volume(cm3): males,1.16, females,1.23. Brackets (I)



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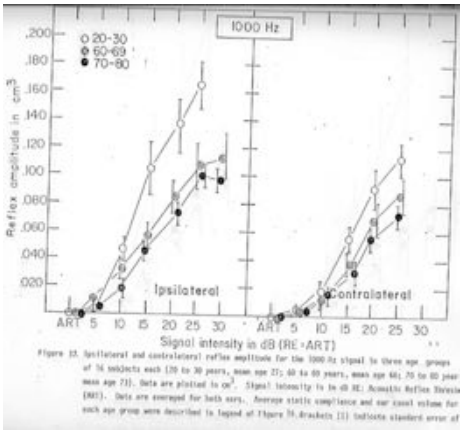
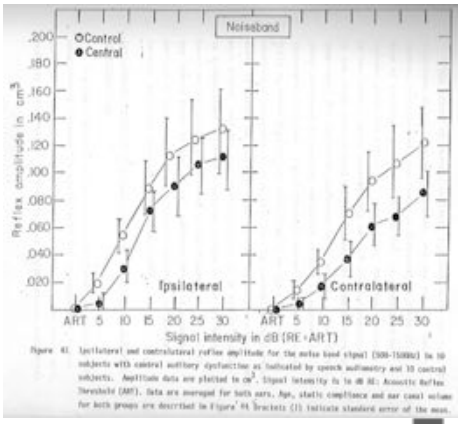
## Common Errors in Aural Immittance Measurement:
*Rarely Applied Yet Clinically Valuable Acoustic Reflex Measurements*

**Acoustic Reflex Amplitude**

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Norris TW, Stelmachowitz P, Bowling G & Taylor D (1974). Latency measures of the acoustic reflex. *Audiology, 13,* 464-469

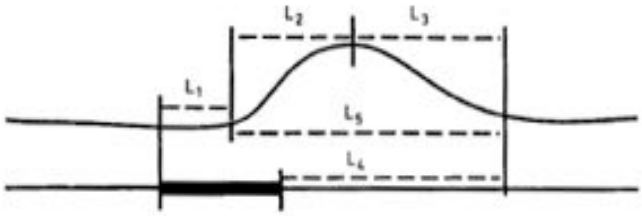


*Fig. 1.* Measurement technique.

*Table II.* Mean values for each latency condition

| | $L_1$ | $L_2$ | $L_3$ | $L_4$ | $L_5$ |
|---|---|---|---|---|---|
| Normal group | 129.1 | 245.2 | 282.2 | 395.2 | 527.4 |
| Sensorineural group | 136.5 | 294.3 | 595.2 | 753.9 | 889.6 |

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## Common Errors in Aural Immittance Measurement: *Rarely Applied Yet Clinically Valuable Acoustic Reflex Measurements*

**Acoustic Reflex Latency**

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