

SPAU 426

Clinical Practicum in Audiology II

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Admittance Testing

Acoustic reflex pathways –ipsilateral and contralateral

Factors affecting acoustic reflex thresholds (ART)

Measuring ART

Diagnostic applications of ipsiand contra-lateral reflexes

Acoustic reflex decay

Immittance Audiometry

RECAP:

- Admittance: reciprocal of impedance. Refers to the ease with which energy will move through a system
- Acoustic impedance: To obstruct or retard
- 3 components: Mass, stiffness and resistance Includes: Tympanometry: ECV, MEP, MEC

Immittance Audiometry

Also includes:

- Acoustic reflex ipsi-lateral and contralateral
- Acoustic reflex decay
- Non-acoustic reflexes

Acoustic reflex testing

Detection in the change of 'stiffness' of the ossicular chain and eardrum after presentation of loud sounds

Occurs when the stapedius muscle, located in the middle ear, automatically contracts as a result of a loud enough sound (acoustic stimulation) at intensities 70dBSL–95dBSL. This normally will occur bilaterally!

Reflex will occur only if the following are intact and functional:

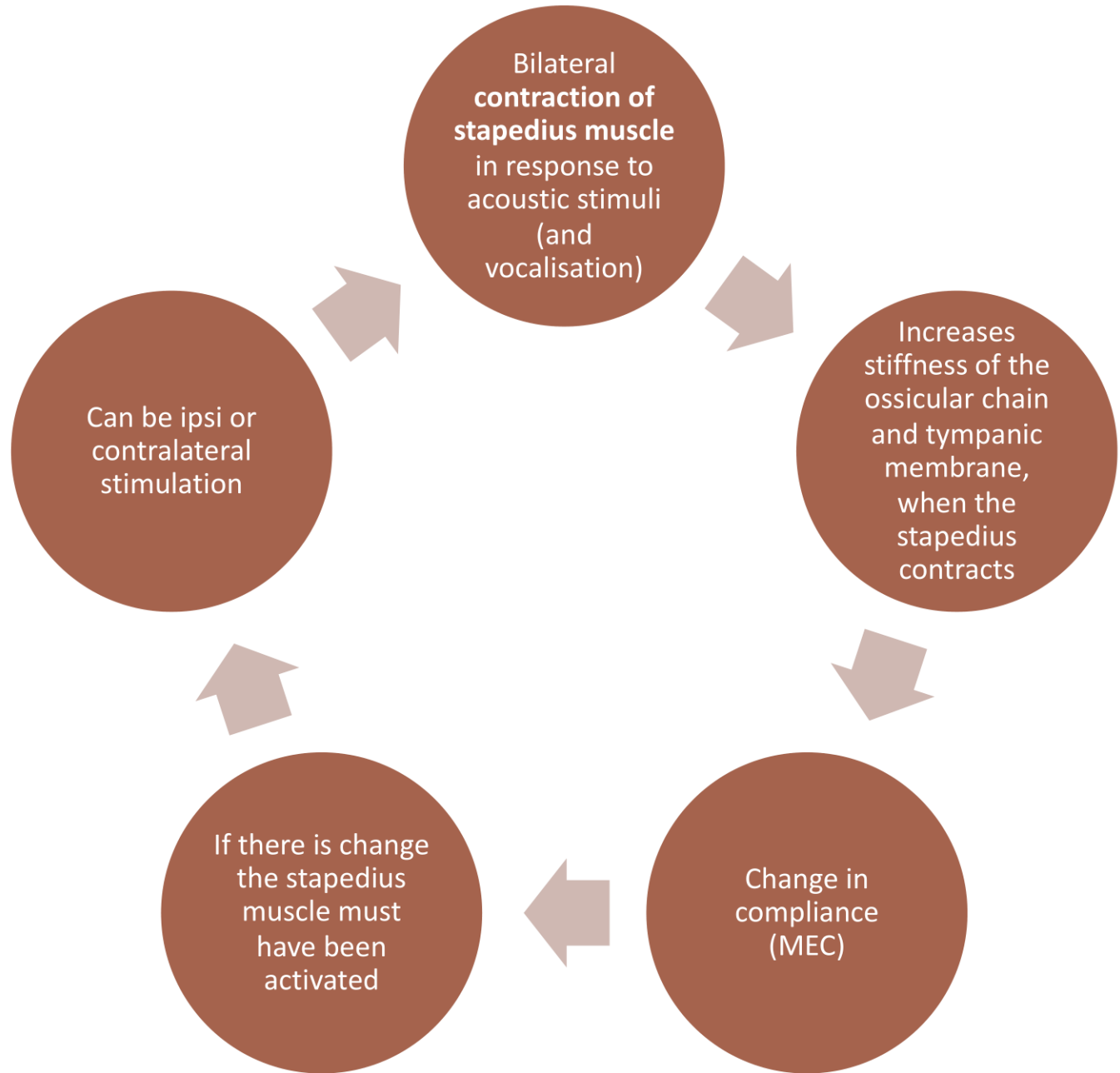
Middle Ear

Cochlea

Auditory Nerve

Stapedial branch of CN VII

Acoustic Reflex



Important Note

- The immittance test or procedure is NOT measuring the ear muscle contraction directly, but is actually measuring the *effect of the middle ear muscle contraction on tympanic membrane stiffening*
- **Clinical Implication: Interpretation of results**
- The ASR is observed as a decrease in admittance, time locked to the stimulus, for the probe tone that has been used to monitor the ME immittance

Definition -Acoustic Reflex Threshold

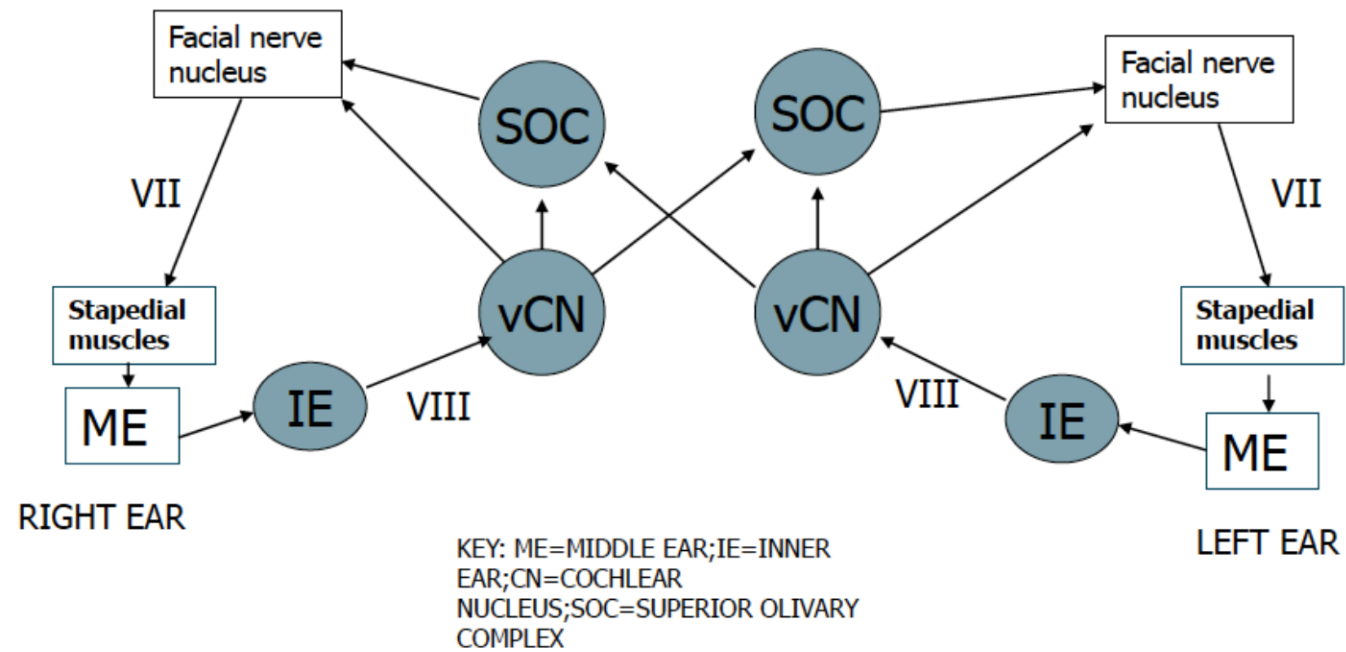
- Lowest stimulus intensity level that causes a change in acoustic admittance of the middle ear of ≥ 0.02 ml equivalent air volume.
- In normal hearing occurs at 70-95 dB sensation level
- Presence of reflex at normal levels confirms continuity of VIII nerve (up to superior olive where reflex is mediated) and the VII cranial nerve

TEST	➤ Stapedial Reflexes
AGE	➤ Any
CONDITIONS TO BE MET	➤ still 5-10 mins, relaxed
USES	➤ Recruitment, ➤ Check reflex arc
CONTRAINDICATIONS	➤ Abnormal tympanogram
Comment	➤ Beware test artefacts

Stimulation and Recording

- Results plotted in terms of ear stimulated
 - In “left contra” probe in Right (STIMULUS IN LEFT)
 - In “right contra” probe in Left (STIMULUS IN RIGHT)
- Look for onset and offset of compliance change
- Check by increasing intensity, > growth in response
- Contralateral generally more reliable than ipsi

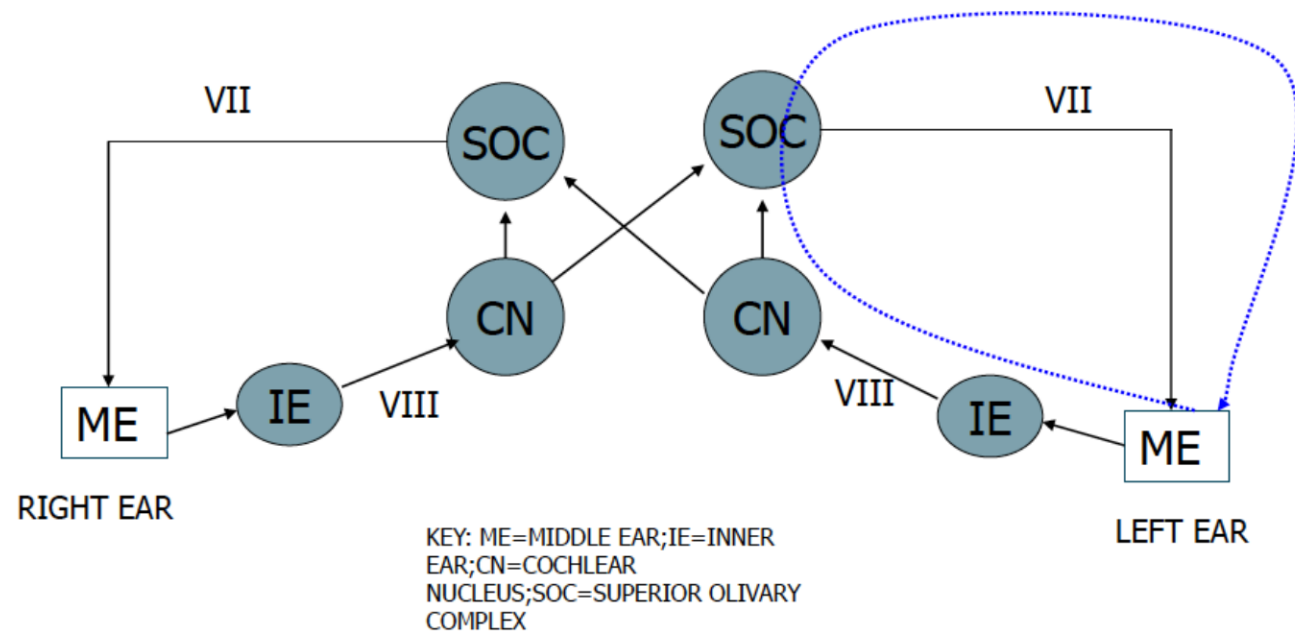
Acoustic Reflex Pathway



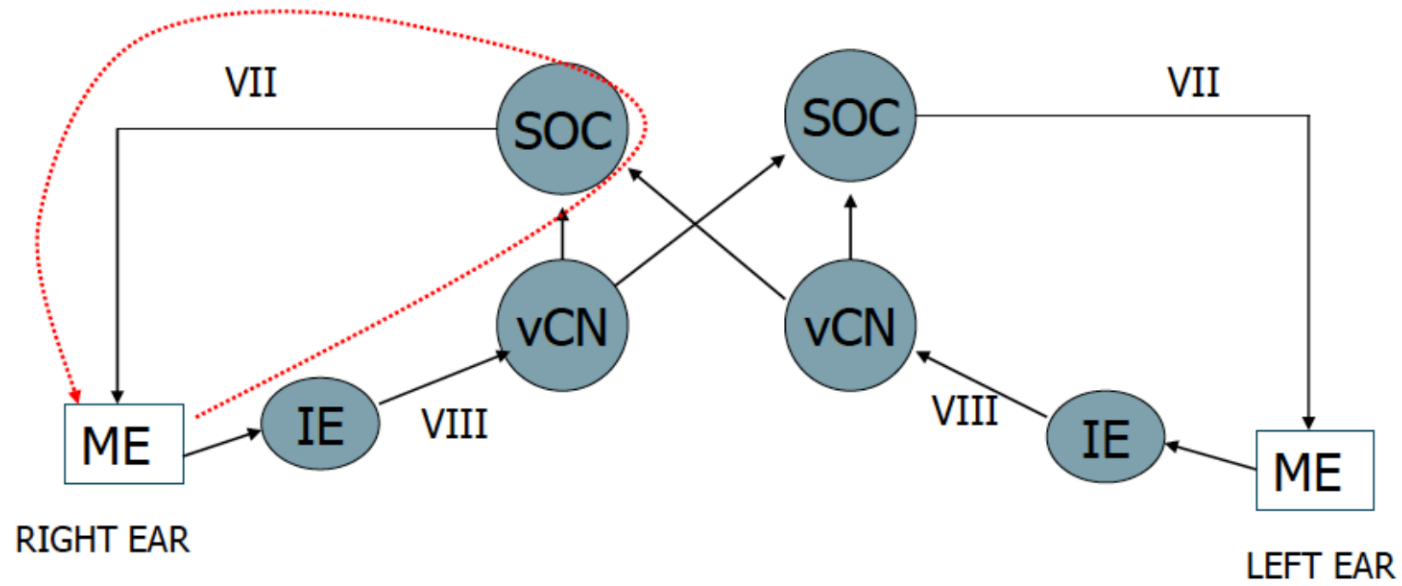
The Ipsilateral Acoustic Reflex

- Same ear for stimulus ear (activating signal) and the probe ear (acoustic reflex response made)
- As pure-tone signal for ART and probe signals are presented through the same tube, ipsilateral acoustic reflex, more prone to artefacts and calibration problems.

Left Ipsilateral Pathway



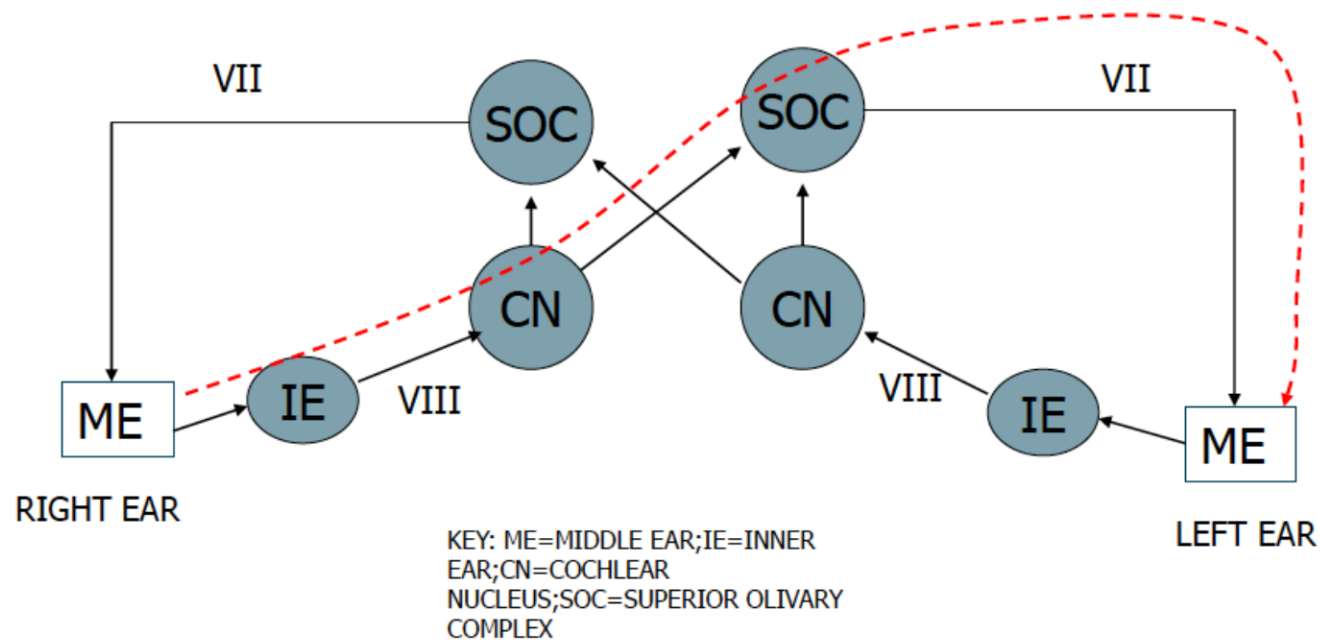
Right Ipsilateral Pathway



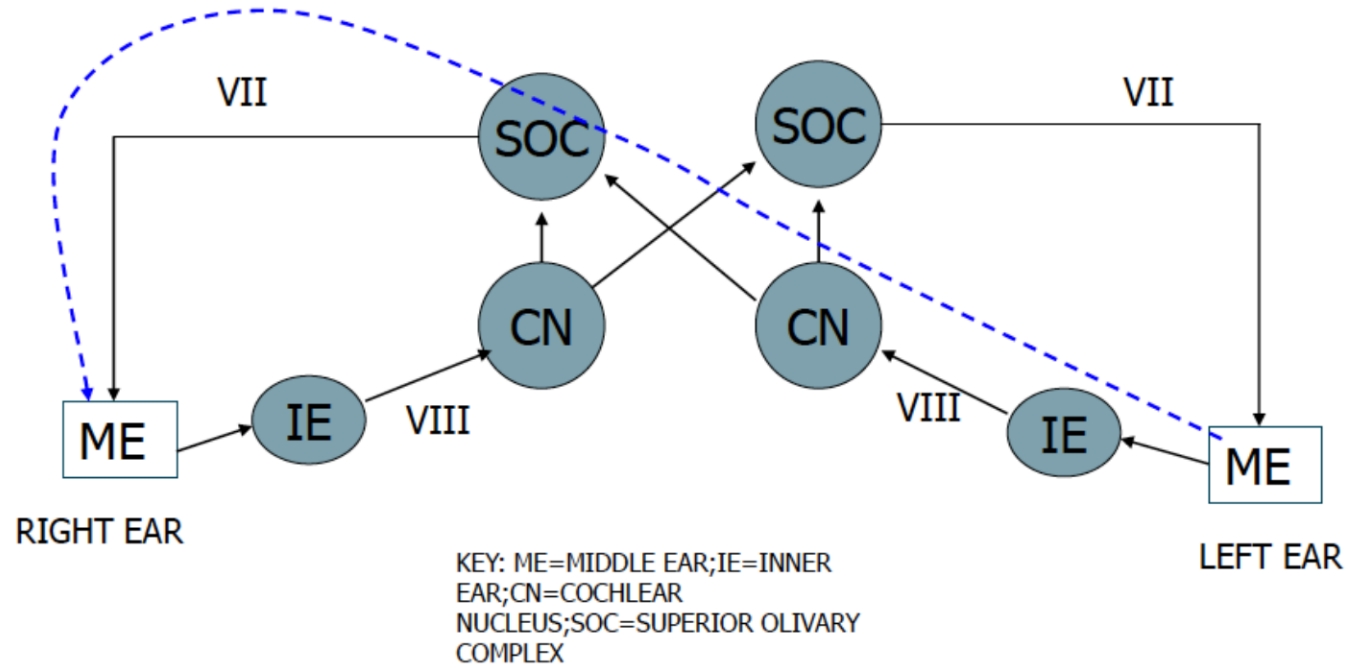
Contralateral Reflexes

- One ear receives the stimulus and the other ear (contralateral) immittance change is monitored and its response recorded
- Relatively free of artefact and calibration issues

Right contralaterally *Stimulated* Pathway



Left contralaterally *Stimulated* Pathway



Characteristics of Contralateral & ipsilateral Reflexes

- Clinical acoustic reflex threshold testing is done for the 500, 1000, 2000 and 4000Hz tonal stimuli
- ARTs for wide band stimuli, e.g. BBN, approx 20 dB lower intensity level of ARTs than for tonal stimuli
- Robust response: Test-retest differences in the ART usually less than 2 dB

Hearing Thresholds (HL)	Acoustic Reflex Thresholds (10th–90th Percentiles; dB HL)		
	500 Hz	1000 HZ	2000 HZ
0 – 25	75–95	75–95	75–95
30 - 40	75–95	75–95	75–100
45	80–95	80–95	75–105
50	80–100	80–100	80–105
55	80–105	85–105	85–110
60	85–105	85–110	85–115
65	90–110	90–110	90–115
70	95–115	95–115	90–120
75	95–120	95–120	95–125
80	100–120	100–125	100 to >125
85	100 to >125	100 to >125	110 to >125
≥90	>125	>125	>125

Normative values for acoustic reflex thresholds (modified from Gelfand, Schwander, & Silman, 1990)

Normal ART for Different Test Stimuli

	500	Pure-tones (Hz)			Broadband Noise
		1000	2000	4000	
<hr/>					
Contralateral ART:					
Mean	84.6	85.9	84.4	89.8	66.3
Standard Deviation	6.3	5.2	5.7	8.9	8.8
Ipsilateral ART:					
Mean	79.9	82.0	86.2	87.5	64.6
Standard Deviation	5.0	5.2	5.9	3.5	6.9

Effect of Gender, Ageing, and Drugs

- Presence of ARTs equal in males and females
- Prevalence of absent acoustic reflexes is greater in alcoholics than non alcoholics
- Barbiturates and antipsychotic agents can cause an elevation in the ART
- Tonal ARTs are generally unaffected by age
- BBN ARTs are elevated by age (Silman and Silverman 1991)

Absence of Acoustic Reflex

- Conductive loss in probe ear (or other ear if presenting stimulus contralaterally)
- Problem with VIII and/or VII nerve
- Some 'normal' ears
- Pathology may elevate ART
- ARTs occur at reduced sensation levels in ears with cochlear loss -recruitment
- ARTs are typically absent in ears with retro cochlear disorder

Measuring Acoustic Reflex

- No BSA recommended procedure as of yet
- The outer ear should then be pressurized (usually automatically) for maximum admittance (i.e. peak of tympanogram).
- Repeat test four times –four conditions:
 - Left ipsilateral reflex
 - Right ipsilateral reflex
 - Left stimulated contralateral reflex
 - Right stimulated contralateral reflex

Measuring ARTs

- Frequencies tested 500Hz, 1kHz, 2kHz, 4kHz presented for at least 1.5s duration (4KHz less reliable).
- Intensity of stimulus started at 70 to 80dB.
- If AR is NOT detected increase stimulus by 5 to 10dB until AR elicited or maximum intensity of stimulus reached (<110dB).
- If AR is detected, reduce intensity by 5dB until no longer present.

Acoustic Reflex Decay

- A decrease in the strength of the stapedius contraction during continuous stimulation
- In normal ears, adaptation/decay is frequency dependent.
- Greatest adaptation at HF tones
- Less for LF tones
- Very little for BBN

Very good reference for revision and understanding

Acoustic Reflex Threshold (ART) Patterns: An Interpretation Guide for Students and Supervisors *Diana C. Emanuel, Ph.D., CCC-A, Towson University (2009)*

Let's watch!

- <https://www.youtube.com/watch?v=l-Bbi9JHAuQ>
- <https://www.youtube.com/watch?v=Qm7iNM9kSJI>



Questions?

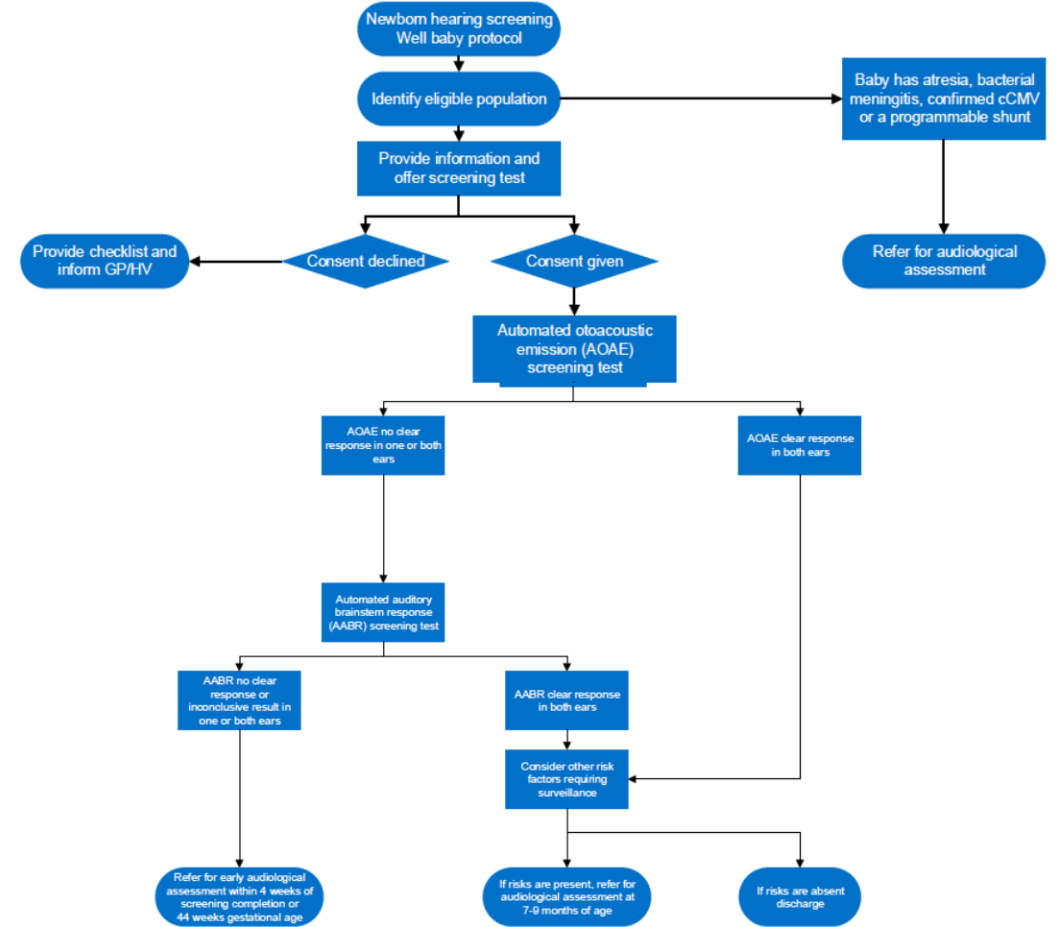
An orange ribbon graphic with a 3D effect, featuring a darker orange shadow on the left side. The ribbon is horizontal and contains white text.

Newborn hearing screening programme (NHSP)

Newborn hearing screening programme (NHSP): care pathways for well babies

- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/796299/NHSP_screening_pathway_-_care_pathways_for_well_babies.pdf

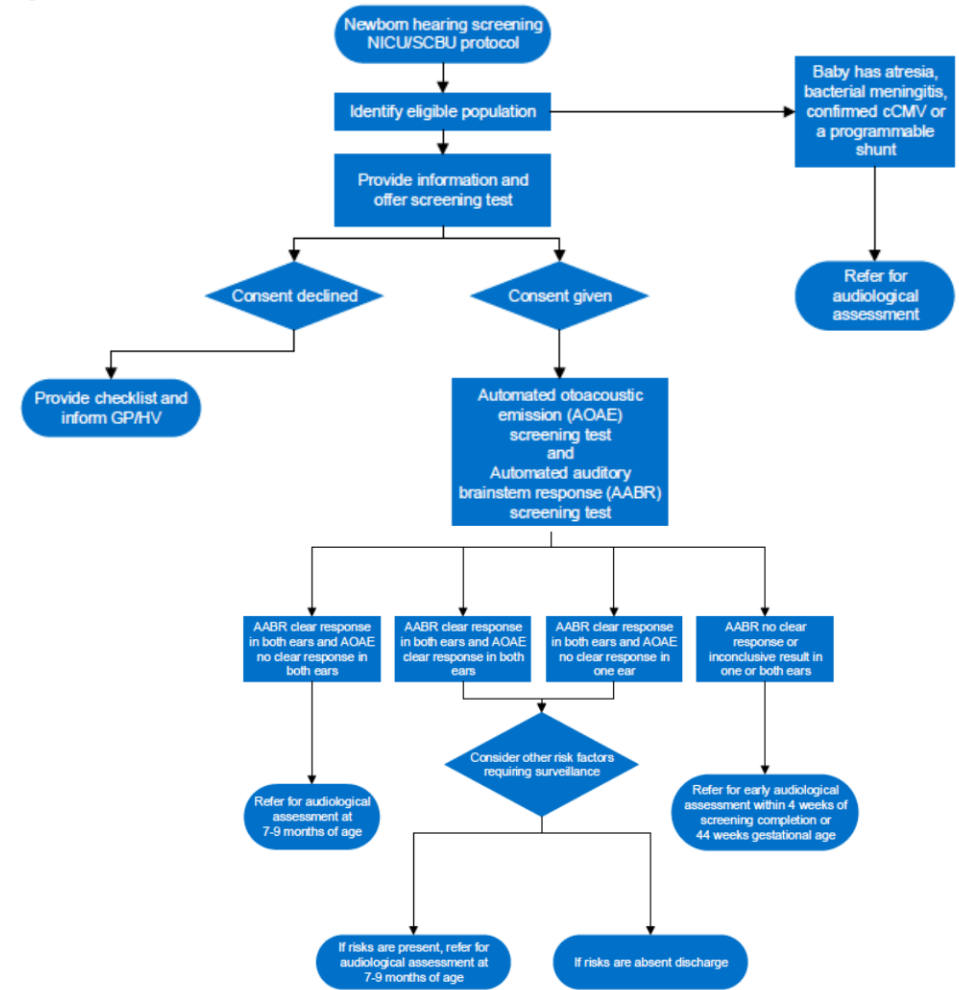
Well baby protocol



Newborn hearing screening programme: care pathways for babies in NICU/SCBU

- https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/796300/NHSP_screening_pathway_-_care_pathways_for_babies_in_NICU_SCBU.pdf

NICU protocol





Paediatric History Taking

Paediatric History Taking

Outline
coherent hx
taking

What to ask?

What areas to
cover?

Why
particular
questions?

Why is hx so important?

Idea of what tests to use

Compare responses in clinic to those reported by parents / carer

Address main concerns – direct management

Pick up risk factors

Pt / family centred care – tailor appointment

General points

Child is your patient – talk to them when appropriate

Older children more involved

Follow a logical progression of questions, but be flexible!

Hx always before testing?

Ask relevant questions

Areas to cover

- Introduction
- Parental concern
- Hearing
- Speech and language
- Otological symptoms
- Birth and pregnancy
- General health and development
- Family hx

Introduction

- Introduce yourself, your colleagues, job title
- Ask them to introduce themselves – relation to child (don't assume they are the parents)
- Older children – introduce yourself to the child
- Take interest in the child – you will need their cooperation for testing
- Explain appt, link to previous appts



Parental concerns

- Apply listening skills
- Make sure you address their concerns
- If they go off on a tangent, allow them to explain and then clarify when appropriate (eg.: worried about grommets)



Hearing

- Hearing behaviour outside clinical setting will give you an indication of what to expect from that specific child and will help you with your management
- Establish responses to sounds (quiet and loud)
- Follow verbal instructions?
- Instructions repeated? Raised voice?
- Sit close to TV?
- Older children – can hear teacher?
- NHSP results? Previous hearing tests?
- School / nursery raised concerns?
- NB: Parents may not have noticed HL – they may feel guilty / bad for not picking it up



Speech and Language

- SAL delay may be due to HL
- Unable to say sounds that they cannot hear
- What are they saying? – important to know what to expect at certain age
- Clear speech – to family / strangers?
- Specific speech problems



ENT symptoms

- ENT referral warranted?
- Ear infections – when? How frequent?
- Discharge
- Exposure to second hand smokers
- Snoring, tonsils, adenoid issues



Pregnancy and birth

- To highlight risk factors associated with HL
- Complications during pregnancy (mother and baby)?
- Prematurity
- Normal delivery / c-section
- Any special care required after birth (NICU / SCBU)
- Ventilation / blood transfusion / jaundice
- Ototoxicity



General Health and Development

- Serious childhood illness – bacterial meningitis, measles, mumps, congenital rubella
- Disabilities / syndromes
- Vision
- Development milestones
- Social development



Family Hx

- Consanguinity – can be a sensitive issue
- Hereditary pre-disposition to HL



Health Professionals

- Are they under any other services
- Ear operations



Further reading:

- Watkin PM, Baldwin M, Laoide S, Parental suspicion and identification of hearing loss impairment. Archives of Disease in Childhood 65: 846-850, 1990.



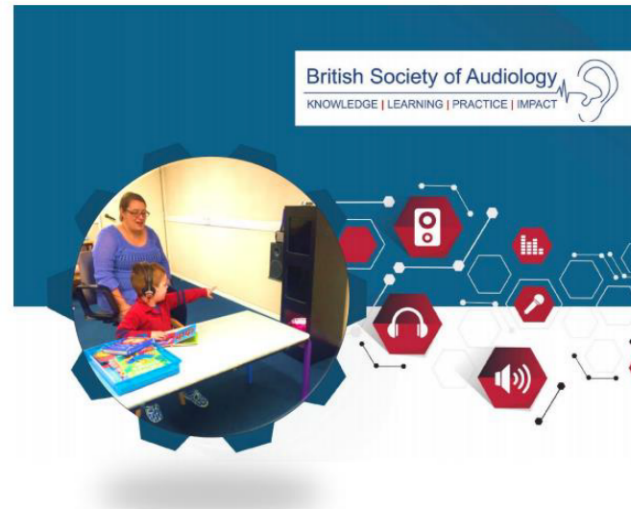
Visual Reinforcement Audiometry

Visual Reinforcement Audiometry

- Age range 8-9 months to 24-30 months
- Based on Conditioned Response –*NOT* Conditioned Orientating Responses for Distraction testing
- VRA successful for 95% of infant population

- **In UK, protocol is for classical conditioning of sound (warble tone) with visual reward** -Start with high level auditory stimulus
- **In US, protocol is for operant conditioning procedure** –Start with low level signal and increase until spontaneous head turn response occurs

BSA recommended procedure for VRA



Recommended Procedure

Visual Reinforcement Audiometry

Date: June 2014

Due for review: June 2019

<https://www.thebsa.org.uk/wp-content/uploads/2014/06/Visual-Reinforcement-Audiometry-1.pdf>

VRA test environment

- Accommodate parent/carer, child & two testers
 - Minimum floor dimensions advised 6m x 4m (BSA, 2008)
- Well ventilated / AC for comfort of child
- Minimal distractions
- Dimmed lighting
 - Avoid shadows
 - Children with visual / complex needs

VRA equipment

- Audiometer with free field warble tones
- Sound field speakers
 - 90° azimuth (reference equivalent threshold sound pressure levels [RETSPLs], are only available for these angles of presentation) relative to, and at least 1m from, the test position to each side (BSA, 2008)
 - Approximately level with the child's head; such positioning provides the most efficient means for conditioning the behavior and establishing Minimum Response Levels (MRLs)
- AC inserts, headphones & bone conductor
- Attractive visual re-inforcer sat 90° (avoid 60°)
 - Approximately level with child's head at a distance of 1-2 meters
- Separate chair at table preferred for child
- Lower chair for parent if child is seated on parent's lap, so child can reach objects on table

VRA set-up option

Two options –Observation Room

1. One-way window looks into test room –need clear view of child’s face and tester activity

- Must be able to hear what is going on in test room
- Both testers must be able to communicate with each other
- Tester 1 “presenter” –presents stimuli through audiometer and operates re-inforcers
- Needs a dialogue with “engager” (Tester 2)

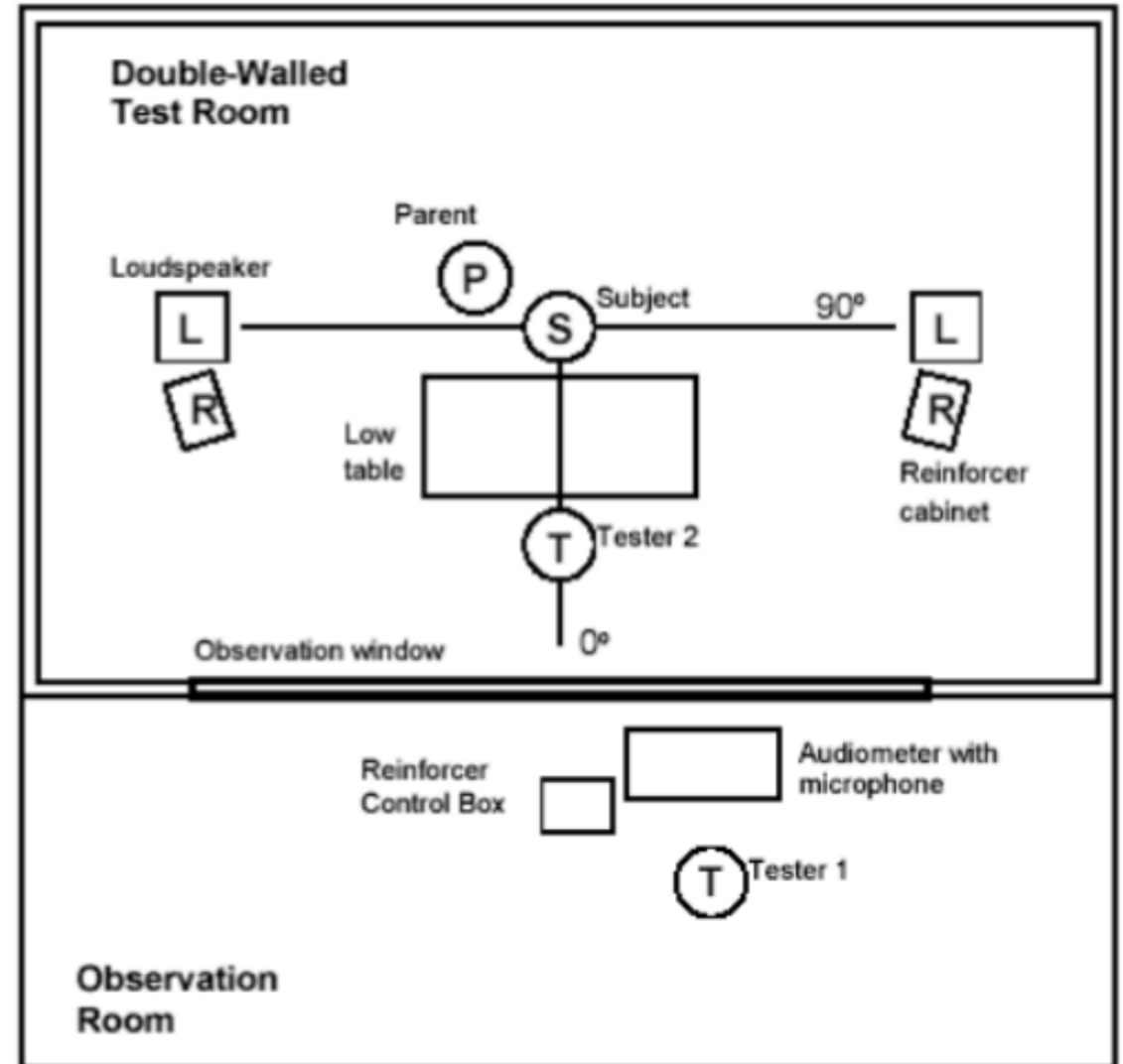
Or

2. both within same room -& above principles still apply

- Pitfall: typically inadequate test set-up & communication between testers

VRA set-up

- Recommended room layout
- Note –Tester 1 is positioned to one side of Tester 2 to allow for direct line of sight of the subject.
- Reinforcer cabinets (and/or reward monitors) should be readily moveable
- (BSA Recommended Procedure for VRA, 2014)



VRA is not the same as DT

- Different to Conditioned Orientating Response (COR)
- 2 parts to (distraction) COR: detection & localization
- In VRA –the child is classically conditioned to turn to light box when he detects the sounds, to see the visual reward (reinforcement) –not a test of localization
- Hearing levels **lower** when reinforcement is used, compared to un-reinforced response

VRA stimuli

- Warble tone / NBN / FRESH noise (0.5, 1, 2, 4kHz)
- Non traditional stimuli –music
- Speech
 - Live voice or recorded
 - Must be calibrated
- Notes on NBN
 - Valid for sound field (as NBN in dBHL not available via other transducers)
 - Less frequency specific
 - Underestimates threshold for steeply sloping HL
- Transducers –SF, headphones, BC, inserts (foam/earmoulds)

Visual reinforcers

- **Study** - (Moore, 1977, J Spand Hr Dis 40: 29-34)
- 4 conditions:
 - no reinf, social reinf, flash light & moving toy
- No rein < reinforcement < toy reinf. Sig more responses
- Child **learns** to turn head to reinforce, **not** the direction of the sound
- Warble tone is **not** inherently interesting, light box is

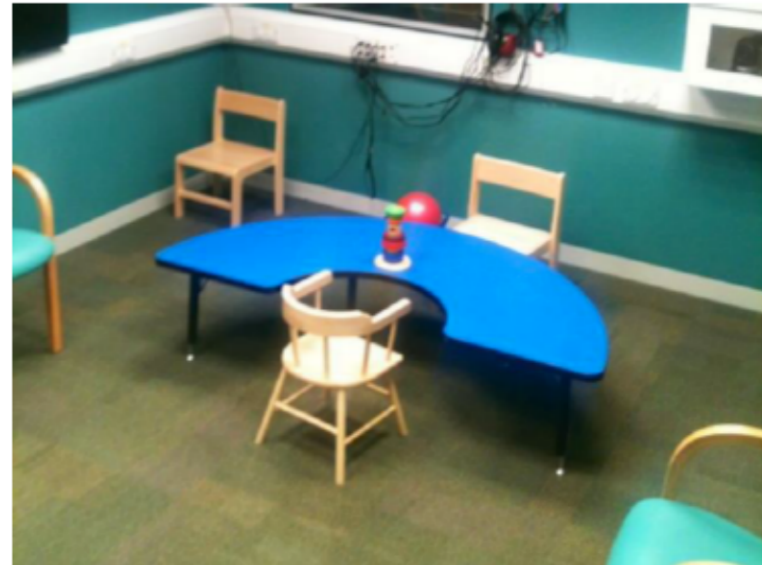
Reinforcers

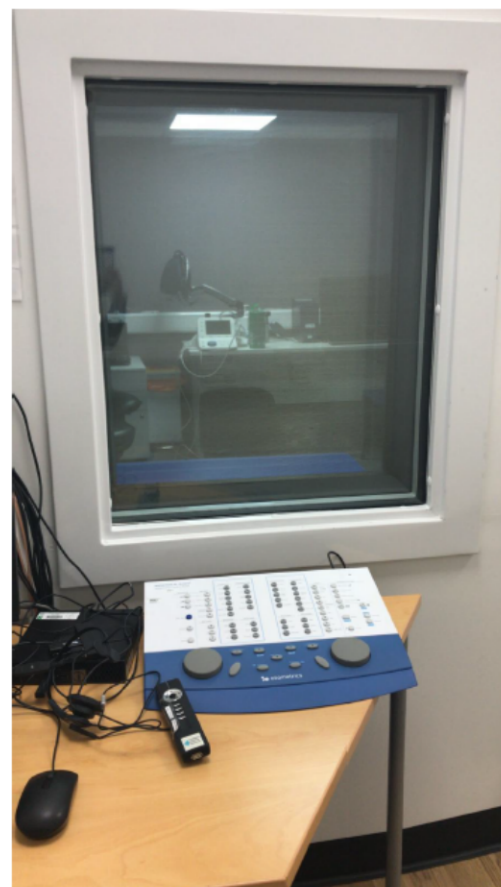
- Toy in a plexiglass box
- Invisible when not activated
- Visible toy with flashing light is not interesting
- Two reinforcers are better than one
- All responses can be in the same direction
- Reinforcers at 90° to child and 1 meter
- Flashing light good for autistic or visual impairment
- Assumption: Interest in reinforcer maintains the response



VRA preparation

- Plan of what you are trying to achieve
 - What is the objective?
- Room setup for VRA
 - chairs/table in position prior to family coming in
 - An activity ready on the table
- Parent needs to sit directly behind the child
- Position of parent behind child's line of vision / no visual cues from parent
- Have toy on engagement table
 - Draws attention to the table





Child preparation

01

Child needs to be settled

- Case history : child development & visual status
- Alertness of child

02

Child may be upset by certain toys, reinforcers & sounds

- IMPORTANT! find out these beforehand

03

Tester 2, child, parent/carer seated in VRA positions at start of the appointment

04

Parent/carer not to cue

Two parts of testing in VRA

Conditioning

Conditioning phase

- Sound stimulus presented with toy reinforcement (classical conditioning phase)
- Child's attention is directed to toy at the outset

Testing

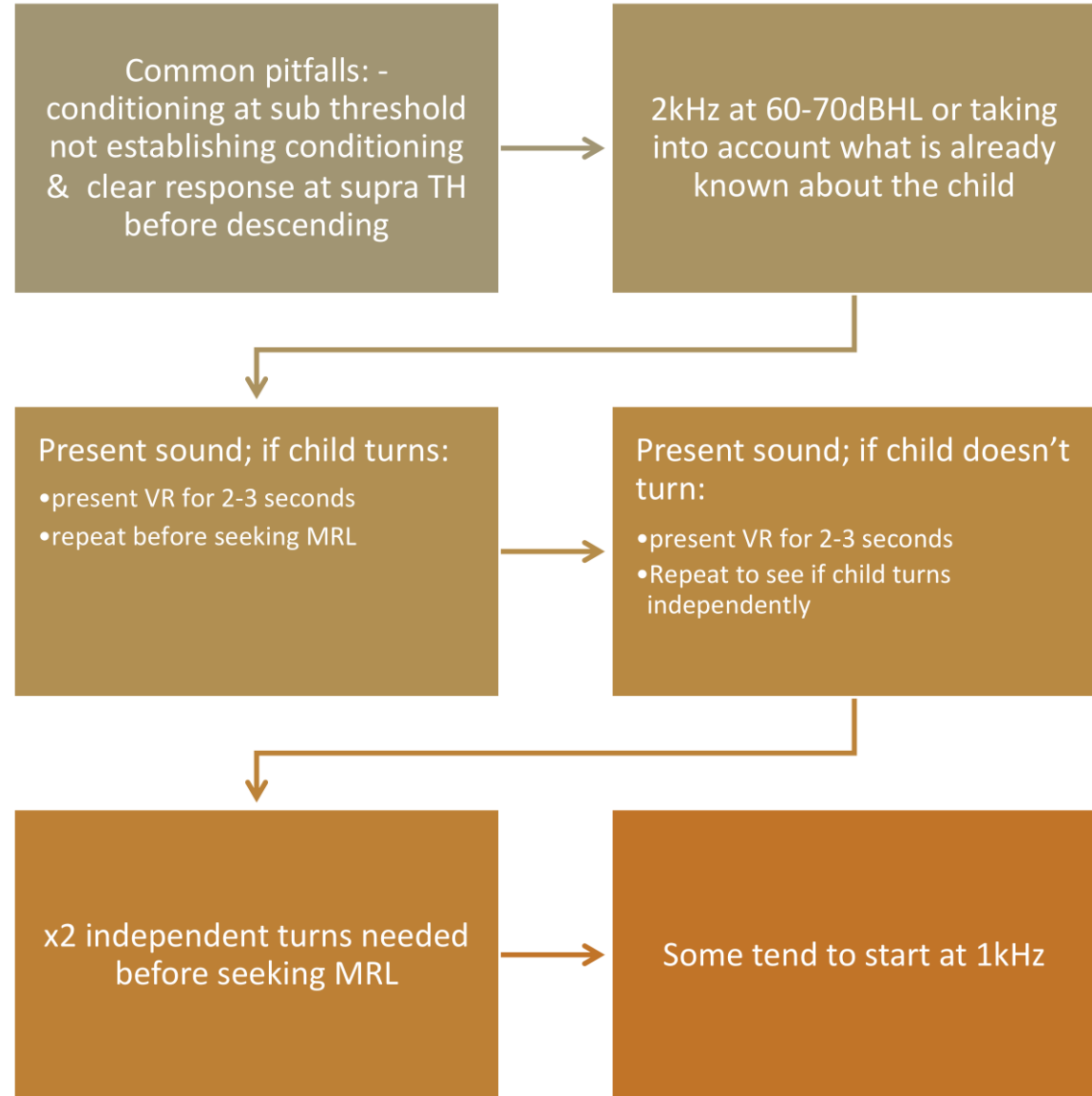
Testing phase (conjugate procedure)

- Sound stimulus presented –child's response is to turn to toy box; toy box is then activated for delivery of reinforcement (lighting toy)
- Valid response within 4 secs of stim. onset
- Helped by social reinforcement of engager

You can fully characterise the hearing impairment with VRA –unlike distraction testing!

- Air conduction
- Separate ears
- Bone conduction
- & masking!!

Test procedure: Conditioning



Test procedure: Conditioning

- Still not responding?
 - Assumption should be that it is not audible and the presentation level increased (e.g. increase by 10dB increments up to 80dBHL; then in 5dB steps louder)
 - MUST MONITOR CHILD'S REACTIONS!
 - Change stimulus type (e.g. NBN) / frequency
 - Use Vibrotactile stimulus (40dBHL at 250Hz)
 - VR visible or interesting? Change the VR
 - Dim the light in the room
 - Is VRA suitable?
 - Developmentally / cognitively not ready
 - Too advance and ready for Conditioned Play Audiometry?

Test procedure: VRA response

- Proceed to test ONLY when two consecutive correct responses are achieved on conditioning
- Sound presentation 2-3 seconds
 - Child does not turn; then change presentation level (or stimuli)
 - Child turns; present VR 1-2 seconds simultaneously to sound presentation
 - CLEAR ASSOCIATION: Do not switch VR off before sound is off
- Response recorded by clear head turn & eye focus on the VR
 - Single eye glance or small movement are not clear responses and should be interpreted with caution
 - Incorrect recording of responses is a common pitfall
 - Slight head movement
 - False positive responses

Test procedure: No sound trials

Vary sound
presentation
intervals

Use of no sound
trials

A false positive
response should
be followed by a
no sound trial

Test procedure: Establishing & recording MRL

- Maximize child's attention
- Drop rapidly in 20dB steps
- Around MRL, adopt '10dB down, 5dB up' (BSA, 2011)
- MRL '...lowest level at which a response occurs at least 2 out of 3 ascending trials (i.e. >50%)
- Complete MRL at any one frequency before moving onto another frequency
 - Although sometimes necessary to change stimulus if child loses interest quickly
- Emphasis on quality of responses NOT quantity!
- Pitfalls:
 - Record R & L sound field responses as ear-specific information
 - Do not assume hearing levels

Test procedure: Strategy for frequencies & sound levels

Which frequency next?

- 2kHz → 500Hz → 4kHz → 1kHz
- 1kHz → 4kHz → 500Hz → 2kHz
- Use the information you have ... But ... Is the information accurate?

New frequency presentations at supra TH levels

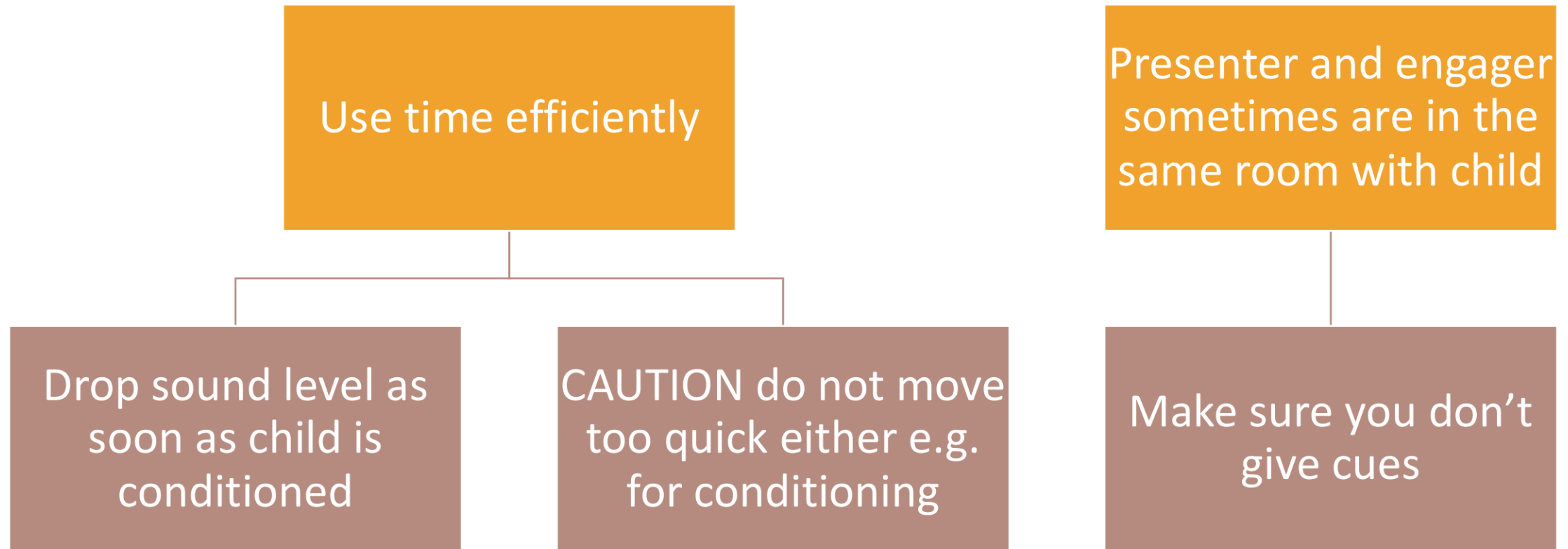
Re-conditioning may be required

- Child is bored / restless

If child no longer responding

- HL or attention?
- Check first frequency for which MRL was established
- 5dB above MRL

Test procedure: Strategy for frequencies & sound levels



Test procedure: Strategy for maintaining child's interest in VRA

1

Maximise child's interest, and thus, length of VRA

- Switch toys, VR
- Take a break
- Change testers
- Use praise/encouragement during conditioning and correct head turn

2

Vary level of enthusiasm when reinforcers are on

- Some children may respond more with more enthusiasm from Tester 2
- Some children may not need the tester to acknowledge the reinforcement

3

With experience and good equipment, expect about 30 to 40

Children with disabilities

- Partially visually impaired / complex needs
 - Bring reward closer to the child
 - Use contrasting visuals
 - Dim room lights
- Severely visually impaired / complex needs
 - Sensory reinforcement
 - Air puffs / vibrotactile
- Motor difficulties
 - Affect head turn responses
 - BOA approach with caution
- Use no sound trials
- Document how response was obtained
- Consider other forms of testing

Correction values

- There are no specific international standards on the RETSPL values for stimuli used for VRA
 - Therefore be mindful of the influence of age of subject and the test method employed when interpreting and reporting results
- Correction values:
 - Only available for normal hearing infants
 - Soundfield
- 7-12 months
- +10dB relative to adult TH (from 0.5 –4kHz)
- MRL at 45dB HL, is equivalent to 35dB HL
- 25dB HL (equivalent to adult 15dB HL) –accepted as indicative of hearing within normal limits

Advantages of insert earphone VRA

- Individual ear thresholds can be obtained
- Higher levels of stimulation possible than with soundfield
- May be done via child's ear mould if hearing aid wearer
- Greater inter aural attenuation with reduced need for masking
- Elimination of collapsed ear canal difficulties
- Reduction of ambient noise effects
- If profound loss, easier to condition with inserts than soundfield signals even with hearing aids in

Disadvantages of insert earphone VRA

- More time consuming
- Child may pull out earphones
 - Get good insertion and keep child busy
 - If on lap, hold hands down
- Head turn response may be less clear or more difficult to condition

How to record responses

- Response sheet should be integrated into the child's ongoing medical record
- Need to specify if 'soundfield or inserts / headphones'
- Right or left ear, bone conduction and signal used (warble tones, NBN, Fresh noise or music)
- Mark responses (with a tick) and non-responses (with a cross)
- Must have a system that records non-responses
- Need a transparent system for recording whether

AUDIOMETRY CLINICAL TICK SHEET – FOR INTERNAL USE ONLY (Please refer to final report) BOA / VRA (please circle one)

Name: _____ Date of Birth: _____

Date of test: _____ Testers: _____

Comments / Reliability:

Key: ✓= response X= no response

500Hz					1kHz					2kHz					4kHz				
0					0					0					0				
5					5					5					5				
10					10					10					10				
15					15					15					15				
20					20					20					20				
25					25					25					25				
30					30					30					30				
35					35					35					35				
40					40					40					40				
45					45					45					45				
50					50					50					50				
55					55					55					55				
60					60					60					60				
65					65					65					65				
70					70					70					70				
75					75					75					75				
80					80					80					80				
85					85					85					85				
90					90					90					90				
95					95					95					95				
100					100					100					100				
105					105					105					105				
110					110					110					110				
115					115					115					115				
120					120					120					120				
Minimal Response Level _____ dBHL					Minimal Response Level _____ dBHL					Minimal Response Level _____ dBHL					Minimal Response Level _____ dBHL				

Transducer:
right / centre / left

sound field
headphone
insert
bone

Stimulus:
Warble
FRESH noise
Pure tone
Other
(specify) _____

Condition:
Aided / Unaided

Satisfactory SF hearing
level: ≤ 25dBHL
Satisfactory ear specific/
bone conduction
threshold ≤ 20dBHL

NO SOUND TRIALS:

Localisation: Not Tested
Tested using a Warble / FRESH noise / Other: _____ stimulus, at _____ dBHL, at _____ Hz; Good / Poor

Example of
VRA tick
sheet

LING SOUNDS

LING SOUNDS VISUAL REINFORCEMENT AUDIOMETRY CLINICAL TICK SHEET

FOR INTERNAL USE ONLY (Please refer to final report)

Name: _____ Date of Birth: _____
 Date of test: _____ Testers: _____

Comments / Reliability:

Key: ✓= response X= no response

MMM		EEE		OOO		AAA		SHHH		SSS	
0		0		0		0		0		0	
5		5		5		5		5		5	
10		10		10		10		10		10	
15		15		15		15		15		15	
20		20		20		20		20		20	
25		25		25		25		25		25	
30		30		30		30		30		30	
35		35		35		35		35		35	
40		40		40		40		40		40	
45		45		45		45		45		45	
50		50		50		50		50		50	
55		55		55		55		55		55	
60		60		60		60		60		60	
65		65		65		65		65		65	
70		70		70		70		70		70	
75		75		75		75		75		75	
80		80		80		80		80		80	
85		85		85		85		85		85	
90		90		90		90		90		90	
95		95		95		95		95		95	
100		100		100		100		100		100	
105		105		105		105		105		105	
110		110		110		110		110		110	
115		115		115		115		115		115	
120		120		120		120		120		120	
MRL	MRL	MRL	MRL	MRL	MRL	MRL	MRL	MRL	MRL	MRL	MRL
_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial	_____ dB dial
_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA	_____ dBA

Transducer:
 right
 centre
 left
 sound field
 Stimulus:
 LING SOUNDS
 Condition:
 Aided
 Unaided
 NO SOUND TRIALS:

Example of VRA tick sheet –Ling sounds

Example of VRA tick sheet

- Tick sheets must be used for every test
- No sound trials recorded
- Every presentation must be recorded whether as a [x] (no head turn) or [✓] (clear head turn)
- Consider peer review
- Can imply reliability of results

2kHz	
0	
5	
10	
15	
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35	
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100	
105	
110	
115	
120	

Minimal Response Level
_____ dBHL

What is the appropriate engagement level?

Depends on the developmental level and alertness state of child, but consider:

- Age of child
- Attention level of child
- Minimum activity to keep child in midline forward position, yet engaged sufficiently to prevent the child from checking
- Tester 2 provides no change in engagement linked to sound presentation –play stimulus must continue throughout the sound signal presentation
- Pitfall: Use of toys/behaviour by Tester 2 providing little/no engagement for child
 - Leads to false positives
 - Engage not distract
- If child is not interested in play, toys need updating

VRA vs DT thresholds Wilson et al. (1976)

- Infants aged 6-18 months
- Soundfield VRA thresholds were on average lower than DT thresholds
- VRA thresholds showed less variability (10dB) than DT thresholds (45-50dB) in normal hearing infants
- VRA thresholds did not vary much as a function of age and were only slightly above those of adults tested using the same procedure
- DT does not give appropriate level of certainty

VRA vs DT comparison

Test	Distraction Testing	VRA
Conditioning	No	Yes
Presentation / Stimuli	Hand held warbler Live voice Manchester Rattle Angle: 135°	Loudspeaker (dB HL) Inserts / TDH BC Angle: 45-90°
Response	Head turn	Head turn
Age range	6-12 months (max. 15)	6-24 months
Reinforcement	Social / simple visual	Complex visual

Advantages of VRA over DT

- More frequency specific
- Able to maintain interest for longer
- Able to determine type of HL (AC/BC)
- Able to determine specific MRL
- More robust (fewer pitfalls)
- Stronger, more effective reinforcement (colour, movement, tailored to child's interest)
- Conditioned response –more repeatable than unconditioned
- VRA successful in 80-90% of cases (Widden, 1990)
- Good test-retest reliability (Wilson, 1981)
- MRL's within 15dB of adult estimates (Berg & Smith, 1983)

An orange callout box with a white border and a shadow effect, containing the text "Conditioned Play Audiometry (CPA)".

Conditioned Play Audiometry (CPA)

Conditioned Play Audiometry (CPA)

Operant conditioning –individual's behaviour is modified by its consequences

Positive reinforcement –verbal praise following child's correct response

From 24 months onwards

- Conditioning child to make a response to an audible signal
- Select toy with small number of responses
- Two testers needed, need communication if second test room set up
- Soundfield to condition if child is being tested for the 1st time
- Headphones to maintain attention and play task
- Comfortably seated in own chair

Conditioned Play Audiometry (CPA)

- Sound must be audible
- Start at high intensity e.g. 70dBHL
- Hold toy beside sound source, or by ear if headphones
- Use simple task such as drop a brick, man in the boat
- Demonstrate task with little explanation
- Check child is able to wait for signal
- Present signal
- Decrease signal intensity by 10-20dB
- If no response, increase signal level –
 - WITH NO VISUAL CUES THAT CHILD MISSED THE SIGNAL
- If response made without signal, take back the brick

Test signals, and order

- Warble tones
- Mid frequency (1000Hz)
- High frequency (4000Hz)
- Low frequency (500Hz)
- Results indicate whether separate ears of bone conduction next priority
- Use headphones or inserts
- Use bone conductor (with foam around the headband)

VRA vs conditioned results

- How to decide whether to use VRA or conditioning?
 - If a child can condition, usually too old for VRA
 - Aim for higher level (conditioning) and go to VRA if not able to do
 - Resulting levels are comparable

Practical tips for CPA in soundfield

Have	Have a toy with a small number of simple responses e.g. man in boat
Let	Let child take men out, ready for “game”
Show	Show the child what you want him to do
Leave	Leave a long gap before sound presented
Do	Do two examples then give the child next man
Let	Let them hold the man beside the warbler
Present	Present the sound, but NO visual cues
Give	Give them praise for correct response

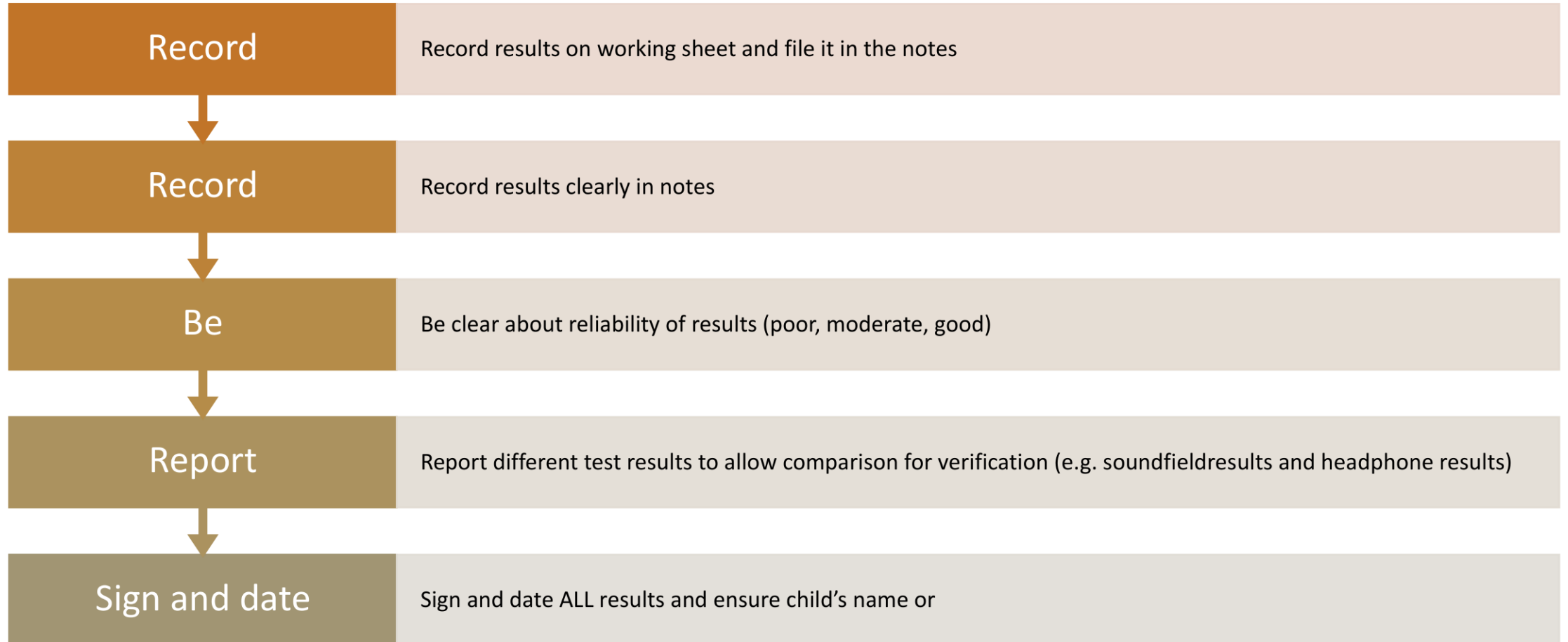
Considerations for headphone/inserts

- Inserts good for smaller children with VRA
- Headphones for conditioning, but be ready to take phone off headband if not happy
- Use hand-held ear phone if not happy to wear headphone, ask parent to hold the ear phone
- Bone-conductor, on mastoid and on headband –work quickly
- Don't ask children a “yes / no” question

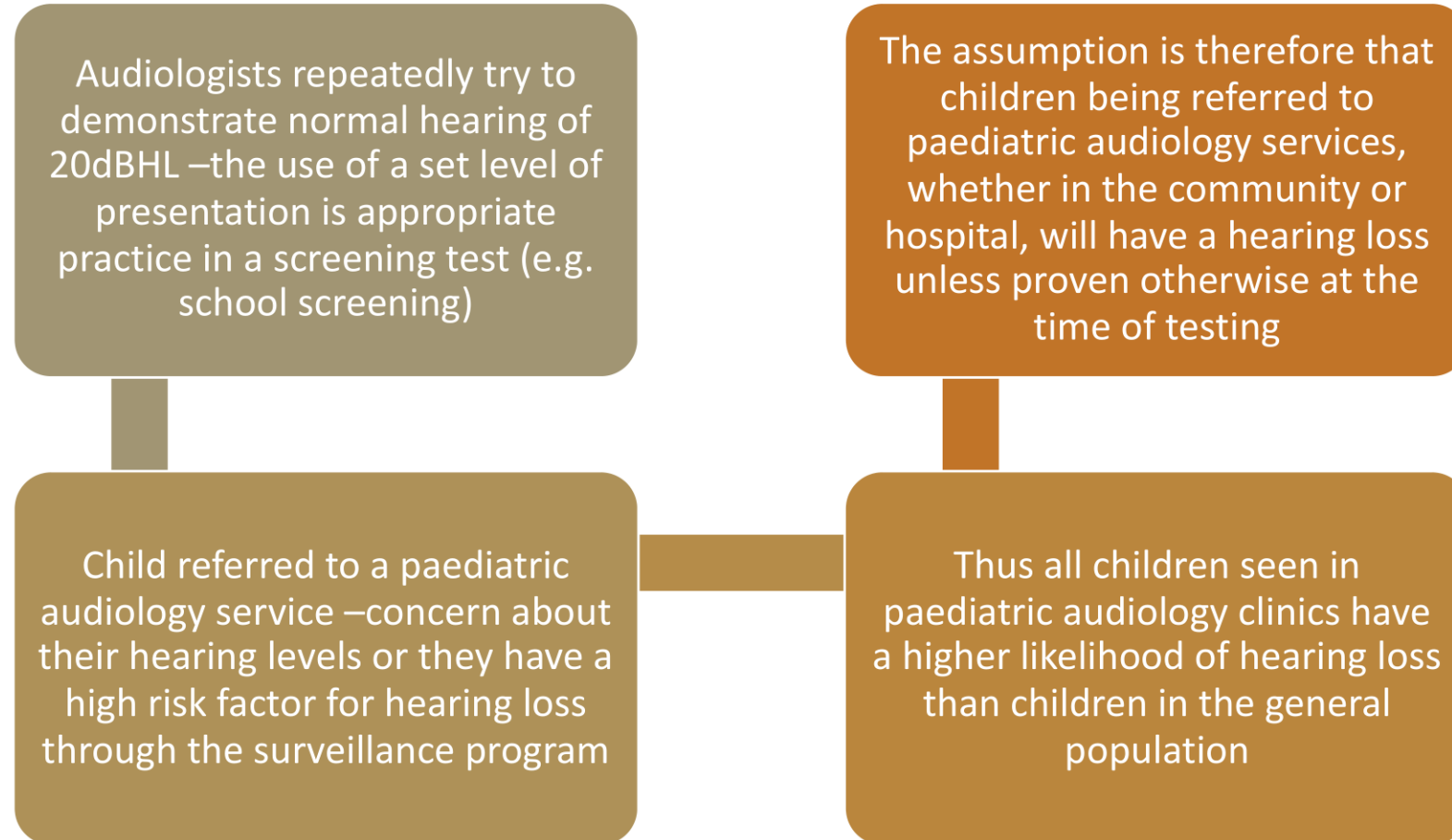
Basic good practice for paediatric testing

- **Assume each child is hearing impaired until demonstrated otherwise**
- **Use set protocol** (ten down, five up or equivalent)
- **Variable gaps** between presentations
- **Better** to do fewer frequencies with good reliability than more incorrect thresholds
- Always do **two different tests** e.g. soundfield and headphones, or MRL for tones and speech, for confirmation of findings
- Should **not** discharge on one soundfield assessment alone

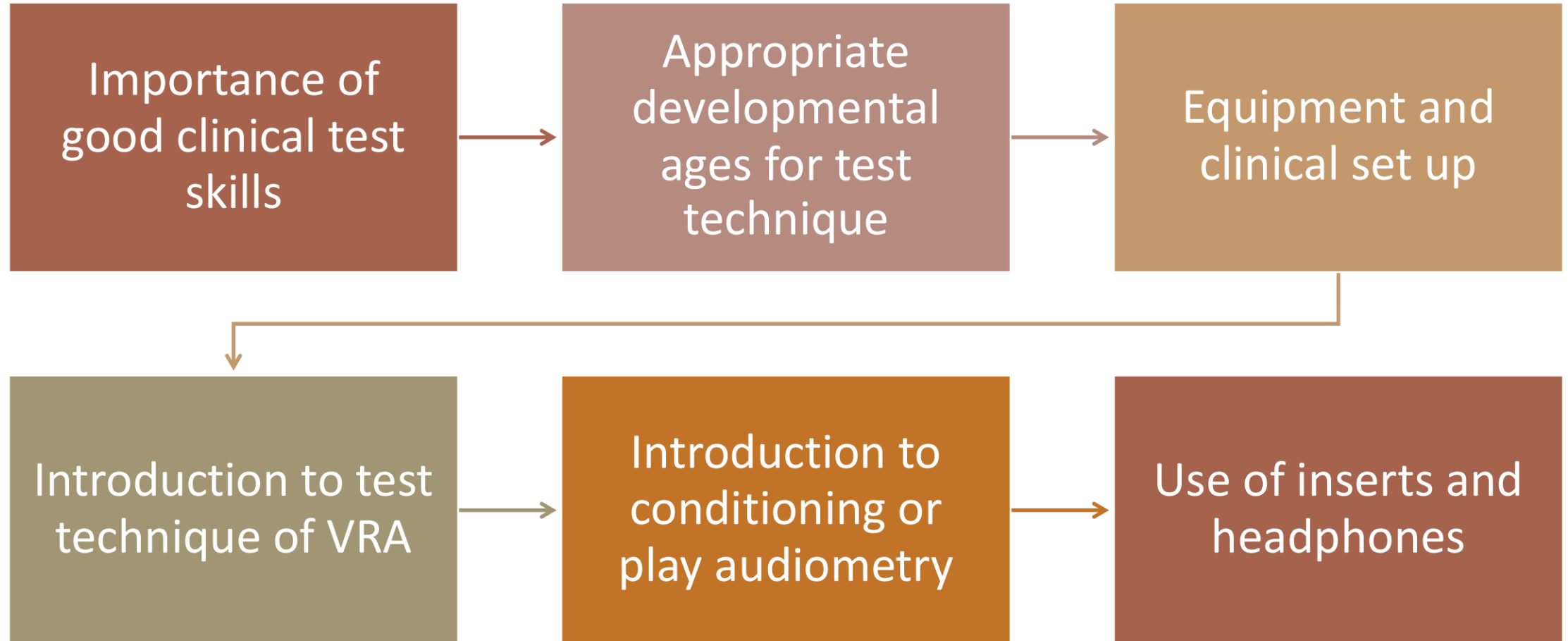
Recording results



Are we aiming to screen hearing or to measure hearing levels in paediatric audiology clinics?



Summary



Essential readings

- VRA and Conditioned responses:
 - BSA recommended procedure for VRA
 - http://www.thebsa.org.uk/wp-content/uploads/2014/04/BSA_VRA_24June2014_Final.pdf
- Objective Hearing Tests (Guidelines for the early audiological assessment and management of babies referred from the Newborn Hearing Screening Programme –on BSA website:
 - <https://www.thebsa.org.uk/resources/guidelines-early-audiological-assessment-management-babies-referred-newborn-hearing-screening-programme/>

Let's Watch!

- <https://www.youtube.com/watch?v=rr2m4fmirAM&t=51s>
- <https://www.youtube.com/watch?v=xleagA8IEh0>
- <https://www.youtube.com/watch?v=S45H3i2ulto>



Questions?

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Complex cases: how to
adapt testing?

What is a complex case?

- Complex cases include:
 - Developmental delay
 - Physical difficulties
 - Severe and profound HL
 - Visual impairment
 - Attention deficit hyperactivity disorder (ADHD)
 - Syndromes
 - Autistic spectrum disorder (ASD)
 - Cognitive delay
 - “I don’t want to”
 - A shy child
 - “Traumatised” child (socially / emotionally)

Prevalence of additional disabilities with deafness: a review of the literature

Report for NDCS (The Ear Foundation, 2012)

- Visual impairment: range of prevalence= 4-57%
- Neurodevelopmental disorder: range of prevalence= 2-14%
- Speech Language Disorder: range of prevalence= 61-88%
- Autistic Spectrum Disorder (ASD): range of prevalence= 2-4.2%
- Cerebral Palsy: range of prevalence= 2-13%
- Pervasive Developmental Disorder (PDD): prevalence= 2%

Non organic HL - Definition

- A hearing loss that appears greater than can be explained on the basis of pathology in the auditory system.
- There is a lack of cooperation, where a person either feigns a hearing loss that does not exist or exaggerates a true hearing loss
- In children can be important indicator of need for help about another aspect of life

Causes of lack of cooperation

1. Patient does not understand the test procedure
2. Is poorly motivated
3. Is physically or emotionally incapable of appropriate responses
4. Is distracted – tinnitus, illness, distress
5. Wishes to conceal a handicap
6. Is deliberately feigning or exaggerating a hearing loss for personal gain or support
7. Is impelled by some unconscious motivation

Prevalence in children

Many studies concur that there is a 1-5% prevalence in centres (studies in the 60's)

Girls more than boys (controversial and varied evidence)

Peaks between ages of 10-12 (Andaz et al, 1995, Bowdler and Rogers, 1989)

May report other functional problems (eg. Vision)

Often connected to other social or academic problems

Indications of Non Organic HL

- In The Test Situation:
 - 1. Frequently inconsistent in responding
 - 2. Many false-negative responses with very few/no false-positive responses
 - 3. Extremely slow and deliberate responses

Indications of Non Organic HL

- The Audiometric configuration:
 - Some authors suggested that relatively “flat” and “saucer-shaped” audiograms illustrated NOHL
 - There is no single typical PTA configuration associated with NOHL

Indications of Non Organic HL

- Test-Retest reliability:
 - 1. Lack of consistency on repeated measures
- 1st line of management:
 - Re-instruct & try to give them a graceful way out
 - Motivate the child “good listener”
 - Coax them into “listening harder”
 - Direct confrontation (rarely used)
 - Give them a different task, which distracts them from perceptual threshold that they have set themselves

Indications of Non Organic HL

- The Shadow Curve:
 - Absence of a shadow curve in a patient feigning a hearing loss in one ear.
- Interaural attenuation for:
 - AC = 40 dB HL (supra-aural headphones) / 55 dB HL (inserts)
 - BC = 0 dB HL

Indications of Non Organic HL

- Speech Reception level & Pure tone Average Disagreement:
- In NOHL patients level for speech recognition is usually lower (better) than the PTA (500,1000, 2000Hz in the better ear)
 - Carhart, 1952
 - Ventry and Chaiklin, 1965
 - Ventry, 1976

How to test a child when suspecting of NOHL?

1. Distract them from the response task in PTA
2. Use a combination of ascending and descending method
 - In normal hearers, there should be no difference between either method
 - In NOHL thresholds could be 20-30dB better for the ascending tones than descending (Harris, 1958)
3. Speech testing is the most effective technique
 - Observing speech testing is very powerful for parents in realising what child hears – or more importantly DOES NOT HEAR EVERYTHING CLEARLY
 - Observe child in waiting room
4. Stenger test rarely used in children

How to test a child when suspecting of NOHL?

- Objective Tests:
 - May be helpful to perform objective tests first
- Auditory Evoked Potentials (AEPs)
- Otoacoustic Emissions (OAEs)
- Tympanometry / ART (great diagnostic values in NOHL)
 - Normally: ART = ≥ 60 dB above the PTT
 - Cochlear lesion: ART = ≤ 60 dB
 - NOHL: ART = $\leq 5-10$ dB above the PTT
 - SPAR: Sensitivity Prediction from the Acoustic Reflex (Jerger, 1974)
 - Test for threshold estimation

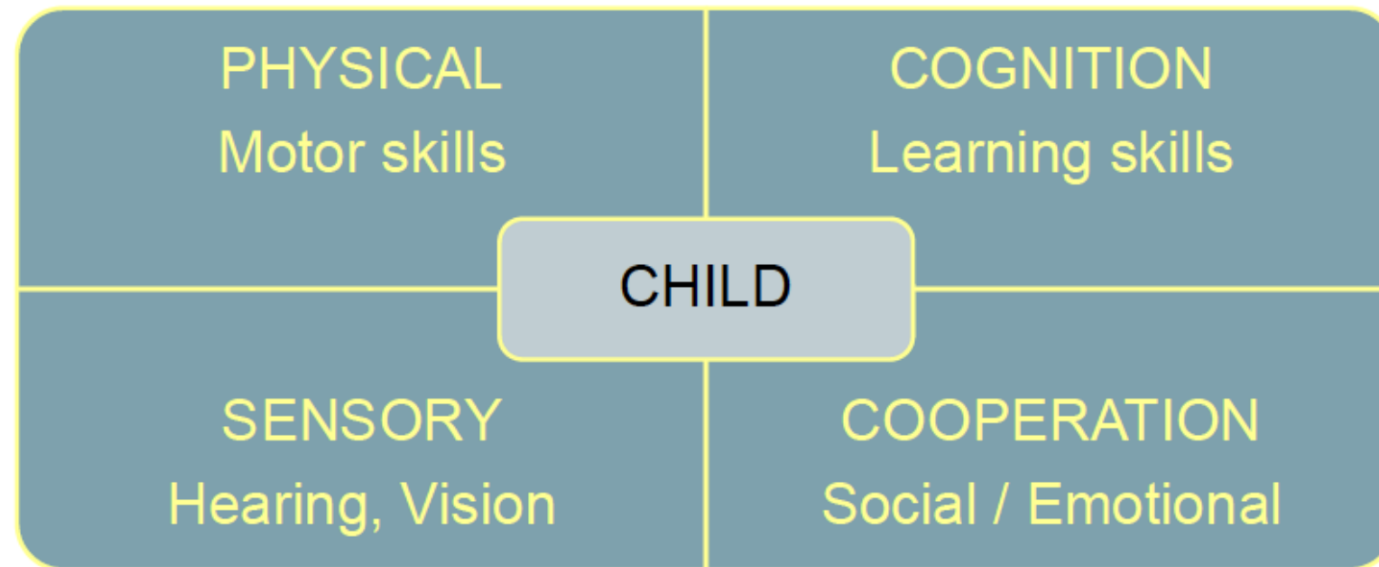
How to de-brief
parents and child
with
suspected non
organic hearing loss

- Try not to be judgemental: don't say "your child's pretending that s/he can't hear well"
- Say something like:
 - child has "lost confidence in hearing ability"
 - "Hearing is fine, listening skills may be poor"
 - "Would you say that x is anxious about something?"
 - "Is there anything that may be bothering x at the moment?"
 - Try and give child a chance to speak to you

Safeguarding children

- Remember: we all have a professional and individual responsibility to keep children and young people safe!
- Abuse can happen to anyone but deaf and disabled children are over 3 times more likely to be abused or neglected than non-disabled children
- It's vital that professionals working with deaf and disabled children follow best practice to keep them safe and protect them from abuse or neglect
- **Always act on your concerns!**

Complex cases – influencing factors



Down's Syndrome

- **Mild presentation**

- Conductive HL
- Developmental delay –
- Late sitting and walking
- Follows simple / familiar verbal instructions at home
- Single word level
- Sign support, Makaton
- Friendly - sociable

- **Severe presentation**

- Conductive / mixed / SNHL – difficulties in aiding
- Visual impairment
- Delayed motor skills wheelchair
- No communication skills
- Autism comorbidity

Severe / profound SNHL

- Considerations

- Difficult to condition to VRA / Play – sounds not audible
- Inexperience of auditory stimuli
- Very visually alert – can fixate on 2nd tester, on toys.
- Remember to use ear defenders as sound levels can exceed noise exposure levels for tester, parent / guardian

- Practical hints and tips to use in clinic

- Condition with VT stimuli (250Hz or 500Hz)
- Use inserts / headphones to test at greater intensities
- May need re-conditioning
- Careful with parents / others giving cues (they can hear the sounds)

Social, Emotional, Autistic Spectrum

- **Considerations**

- Often won't tolerate otoscopy, headphones or inserts
- Works on own agenda
- Resists changes
- Often very active
- May continue to respond to VRA beyond 36 months
- Best with familiar people
- Often unable to attend consistently to auditory stimuli
- May be hypersensitive to loud sounds; may only attend to quiet or loud sounds

- **Practical hints and tips to use in clinic**

- Social story, pictures of otoscope, transducers – child knows what to expect
- Use parents to demonstrate
- Find out in advance what is interesting to the child
- Find out in advance what distresses the child
- Typically habituate quickly, try a range of stimuli
- Try to position the child so it's hard to move away

You may want to read this story to your child

My name is _____ and I am going to have my hearing checked.

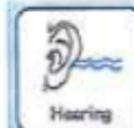
My _____ will go with me to the clinic. I will go up the stairs or in the lift to the audiology department. I will wait my turn because other people are having their hearing checked. I can play with toys while I am in the waiting room. When it is my turn the audiologist will take us to the testing room. The room is special, it is very quiet inside.

Two grown ups will check my hearing. They will talk to my _____.

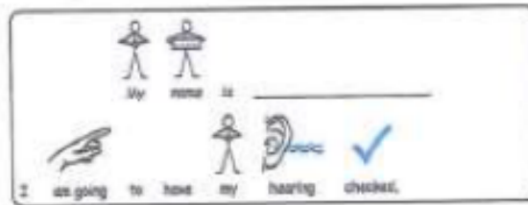
One of the grown ups will explain and show me what to do.

I will listen to sounds and might wear headphones.

When I have finished all of the activities I can go.



Having your hearing checked



Information to help children understand what will happen when they have hearing tested

Social story

? What will happen?



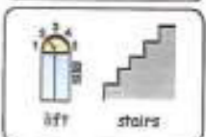
I am going to have a hearing check.



My _____ will come with me to the clinic.



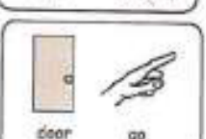
I will wait in the waiting room with the toys.



I will go in the lift or up the stairs to the room.



I will play listening games with the grown ups.



Then it will be time to go.

Children's Audiology Centre →

When I get to the second floor I will turn right.
I will find the Children's Audiology Centre.



We will say hello to the receptionist and then we will wait in the waiting room.



This is the corridor that leads to the quiet test room where I will play listening games.



Social story

Cognitive developmental delay

- **Considerations**

- Cognitive age determines which test
- May respond very rapidly if hypersensitive to sound
- Is the child interested in reinforcer?
- Is the child distressed by VRA toys?
- Is the child over fixated on visual reinforce or tester's distraction?
- Does the child has a limited attention span?

- **Practical hints and tips to use in clinic**

- Establish motor and play skills through interview and observation
- Have toys on the table and observe how child plays
- Try just light, video or favourite character / toy as reinforce
- Change task frequently – build a story

Physical - motor skills

- For VRA / DT - upper body trunk and head needs to be steady for head turn
- Look for consistent pattern of response after sound presentation – often delayed?
- Careful with timing of stimuli presentation
- Choose a task the child can manage



e.g. response buzzers

Sensory – visual impairment

VRA

- **Partial visually impaired**
 - Bring reward closer to child
 - Use contrasting visuals (flash / strobe light /disco ball)
 - Dim rooms lights
- **Severely visually impaired / complex needs**
 - Sensory reinforcement
 - Air puffs / vibrotactile
 - Sensory distraction / engagement – play doh

Conditioned Play Audiometry

- Child should be wearing glasses
- Choose toys that can be manipulated by the child
- Clap as a response



Complex cases – you will need...

- Longer appt time (45 minutes or more)
- Adapt test environment for the child's needs
- Plan wisely – testing opportunities may be limited
- Be prepared to modify test method, order of testing and content of test
 - One can't know how a child will cooperate until they are in clinic
 - Be flexible and creative
- Stop the test and re-appoint if necessary
- **QUALITY NOT QUANTITY!**
- Experience ensures confidence

Assessing the complex needs population requires specialist Audiologists with experience and knowledge about the potential pitfalls and interpreting responses

As a minimum, a three-way team is recommended:

- Experienced paediatric audiologist with good understanding of multisensory impairment and complex medical conditions
- Multi-sensory impairment (MSI) or experienced Hearing Impaired (HI) teacher with hands on experience of children with complex needs
- Parent/carer enabled and expected to be the expert on their child 29

Unilateral and mild bilateral SNHL

- Traditionally children with unilateral and mild bilateral SNHL did not get fitted with HAs
 - Now changing
 - Dept dependent
- Concern now as children do not have good outcomes
- The Ear Foundation report to NDCS: Mild-moderate hearing loss in children, May 2015
 - Greater levels of effort for the children and young people in school
 - Diagnosis and fitting of aids later than in other groups, with an apparent lack of care pathway and liaison between professionals

Evidence of impact of UHL on speech and language development

- Impact of UHL on speech and language development has been reported for a while now
- And when we look at these studies, we can see that even mild unilateral loss can have a functional impact on achievement and should not be ignored.

Table 1. Studies looking at speech and language development in UHL vs normal hearing children.

Study and Year	Severity of UHL	Number of subjects	Speech / Language Problems
Klee & Davis-Dansky (1986)	>= 40dB	25	Few differences on 6 standardised language subtests (6-13 years)
Borg <i>et al.</i> (2002)	>= 20dB	58	Delayed language development
Kiese-Himmel (2002)	>= 30dB	31	Normal first words but delayed acquisition of 2-word phrases
Colorado HIP (2002)	Varied	15	Significant or borderline language delay in 33%
Colorado Study II (2003)	30-120dBHL	155	8% received speech and language therapy, and in total 53% had other interventions

Table from "ENT & Audiology News, Vol 20, No 3, July/August 2011.

Evidence of impact of UHL on speech and language development

- More recent research also shows language delays, especially in higher language skills such as morphology (formulating sentences, tense errors, formulating plurals) and syntax.
 - Lieu (2012)
 - Villa and Lieu (2015)
 - Kishon -Rabin et al (2015)
 - Fisher and Lieu (2015)
- In these particular studies we see that some children were able to catch up with their language ability, but although language may improve, they still lagged on academic performance.
- Which adds to previous evidence on susceptibility to educational underachievement for children with UHL.

Impact of (mild / unilateral HL)

- **Academic impact**

- In Malaysia students with poor academic performance were significantly associated with mild hearing loss (Duadet al. 2010)
- Children found with minimal or unilateral hearing loss have adverse effects in ... academic life compared to children with normal hearing (Most 2004)(Bess et al 1991)

- **Social impact**

- Children found with minimal or unilateral hearing loss have adverse effects in ... social life compared to children with normal hearing (Most 2004) (Bess et al 1991)
- Children can have both behavioural and self-esteem issues due to hearing loss (Blair et. Al 1985).

Behaviour at school and quality of life considerations

- Issues could be related to frustration and fatigue
- Need higher concentration level necessary for children in poor listening conditions
- Resulting in a lack of co-operation and perceived inattention at school
- These children are using their cognitive resources in listening, not in learning the academic curriculum
- Cannot underestimate the listening effort required which uses greater cognitive resources

Unilateral and mild bilateral SNHL

- Consider aiding
- Need to monitor at least annually
 - Unilateral – ensure that good ear remains good
 - Any progressive element?
- Other management options
 - Soundfield / FM systems
 - Good communication tactics
 - Support from education (may have funding issues depending on borough)
 - ENT – need medical opinion



Questions?

Impression Taking

British Society of Audiology
KNOWLEDGE | LEARNING | PRACTICE | IMPACT



Recommended Procedure

Taking an aural impression

Date: February 2013

Due for review: February 2018

Essential reading

- BSA Recommended Procedure: taking an aural impression, 2013
- <http://www.thebsa.org.uk/wp-content/uploads/2014/04/Impression-Taking-1.pdf>

Taking an impression

- <https://www.youtube.com/watch?v=G07np2W1Hqw>

BSA recommended procedure

- Subject management
- Examination of the ear
- Preparation
- Otostope insertion
- Taking the impression
- Syringe/gun technique
- Removing the impression
- Open jaw impression technique
- Special cases and possible contraindications to impression taking
- Health and safety

Subject management

Explanation of procedure to patient:

- Straightforward explanation
- Warning of the fullness that will be felt in the ear and the
- Possibility of a cough reflex when the otostop is inserted.
- Tinnitus sufferers may also notice a temporary enhancement of their tinnitus during the procedure.
- The subject should be asked about any ear surgery, pain or infection.
- The subject must not speak whilst the impression material is in the ear, but should keep the mouth in the normal, naturally closed relaxed position unless an open jaw impression is to be taken.
- The subject can indicate any discomfort by raising a hand.
- The audiologist should wash his/her hands before examining the subject, and ensure all equipment is clean and disinfected where appropriate.

Examination of the ear

- The ear should be examined thoroughly using an otoscope.
- Any unusual features or abnormalities should be noted and, if necessary, referred for medical advice. (contraindications later in this lecture)
- Otoscopy should be performed seated, not standing, to ensure the ear is viewed properly and to reduce the risk

Select speculum

- Choose a speculum that is the biggest size that will fit comfortably in the ear canal
- Aim for the widest view of the ear possible

Positioning

- Seat your client in a chair with a comfortable back support and arm rests if possible
- Get down to the level of the client's ear

Holding the otoscope

- Hold the otoscope in the hand of the same side as the ear you are about to examine
- Hold the barrel of the otoscope like a pencil
- Rest a finger firmly but gently against the clients cheek or head
- Don't point the otoscope barrel down as it is harder to stop it entering the ear if the client moves

The examination

- Examine the pinna and area surrounding the ear
- With your free hand, gently pull the pinna upwards and backwards to straighten the external ear canal
- Insert the specula in the ear canal
- Move your eye to the otoscope

Viewing the ear

- The first third of the ear canal is cartilage which curves inwards slightly upwards and backwards
- To view the ear you must grasp the pinna and pull back and up to straighten out the canal.

What are we looking for?

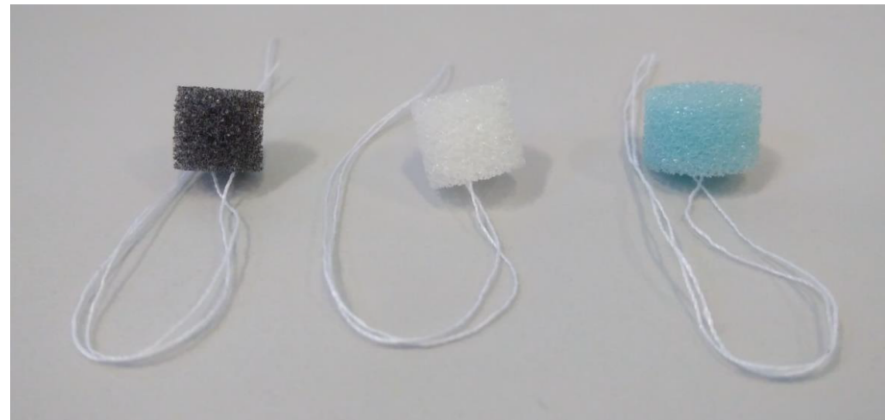
- **External Ear**
 - Lesions in the skin surrounding the pinna
 - Swelling around the ear
 - Irregularities in the shape of the pinna
 - Scars from previous surgery
 - Any unusual features
- **Ear canal**
 - Wax/ other foreign bodies
 - Healthy skin lining
 - Soreness/flakiness
 - Blood or discharge
 - Irregularities in the shape (bumps and lumps)
 - Excessive movement with jaw
 - Length and angle of canal
- **Eardrum**
 - Discharge
 - Redness
 - Scar tissue
 - Perforations
 - Fluid
 - Normal anatomy (light reflex, malleus)

Preparation

- A towel or tissue may be laid over the subject's shoulder.
- Excess hair may be removed from the outer area of the ear canal, if it is essential and with the subject's permission.
- If a postaural hearing aid is to be fitted, it should be placed in position over the pinna whilst the impression is being taken.
- Spectacles and earrings should be worn if they are in everyday use.

Otostop insertion

- Otostops or otoblocks should be used to protect the eardrum and middle ear during impression taking.



What are we looking for?

- Insert otostop into ear using clean self-illuminated pushrod or earlight
- Otostop should be placed just beyond the second bend
- When using the earlight the audiologist's hand must be firmly braced against the subject's head to prevent accidental injury.
- Check otostop position using an otoscope.
- Ensure there are no gaps between the otostop and the canal walls that could allow impression material to pass.
- The strings of the otostop should be positioned so they can be held during syringing to prevent the otostop moving when the impression material is introduced.

Taking the impression

- Impression material
- Syringe technique
- Gun technique



Requirements for impression materials

- The impression should show any abnormalities in the ear
- The material should be easy to work with and flow easily before it is set
- Non toxic and non-irritant to skin
- Reasonable cost
- Once set:
 - Of sufficient mechanical strength not to tear or distort easily
 - Remain stable over time (low shrinkage)
 - Flexibility

Storage

- Ideal temperature range: 15-28 degrees C
- Sensitive to ambient temperature
- Cold: Longer setting time
- Warm: Shorter setting time

Types of Impression Material

- Condensation reaction
 - Releases ethanol
 - Results in shrinkage
 - 1 hour -0.2%
 - 24 hours -0.4%
- Otoform-K, Blue Silicast, Amsil



Types of Impression Material

- Addition reaction
 - No by-products
 - Dimensionally stable
 - Material of choice for severe/profound losses.
 - Otoform A/K, Silasoft, Pink Silicast



Impression material

- Mix according to manufacturer's instructions
- Consistency
 - Should flow out of syringe without undue pressure on plunger being required

Syringe/gun technique

Syringe technique

- Insert nozzle into the ear canal at a point approaching the otostop
- Do not apply excessive pressure
 - May cause discomfort, move otostop or force material beyond otostop
- Brace between syringe and subject's head
 - Avoid accidental injury
 - Prevent otostop moving



Syringe/gun technique



Using an impression gun

- The material for use in an impression gun is delivered in cartridges mixed in a 1:1 ratio by the disposable tip
- Impression guns are available both in manually operated and electric models
- Attach the cartridge as directed by the manufacturer of the impression gun
- Squeeze a small amount of the material out
- Wipe the end of the cartridge and attach a mixing tip
- Squeeze the trigger until the material reaches the end of the tip, and then proceed filling the ear as with a syringe
- When taking impressions on both ears, the same mixing tip may be used as long as the second impression is taken immediately
- Once the material in the tip is hardened, it is not possible to reuse the tip
- After completing the impression, remove the mixing tip on the cartridge and dispose of it
- Place the cap back on the openings of the cartridge

Removing the impression

- Impression is set when pressing with fingernail leaves no mark on material
- Remove slowly and carefully
 - Break air-tight seal that will have developed
 - Ask subject to move jaw
- Check for completeness
- Examine ear again with otoscope
 - Ensure all impression material and otostop have been removed
 - Check for soreness or injury –refer for medication attention

Open jaw impression technique

- High gain hearing aids or completely in the canal aids may need a tighter fitting mould
- Jaw movement may force the hearing aid out
- Using a spacer to keep the jaw open while taking the impression can give a tighter fit
- Users have reported these moulds equally comfortable and sometimes better than closed jaw impressions



Open jaw impression technique

- First ask if the patient has problems with swallowing (choking risk e.g. after stroke)
- Give client a tissue they may dribble
- Ease the impression out carefully
- Be extra careful with otostop placement
- Aim to be 2mm beyond the ear canal second bend
- When the otostop is placed properly, it is usually just barely visible when looking into the ear canal without straightening the canal

Health and safety

- Ensure safety and well-being of subject
 - Equipment in good order
 - Equipment clean and fit for purpose
- Perform otoscopy and impression taking seated
- Do not leave subject unattended
- Only take impressions on both ears simultaneously with subject's full consent

Remember!

- You are the only one who sees the ear from which the impression is made
- The manufacturer can only process what you send
- If the impression does not look anatomically

The cost of poor impressions

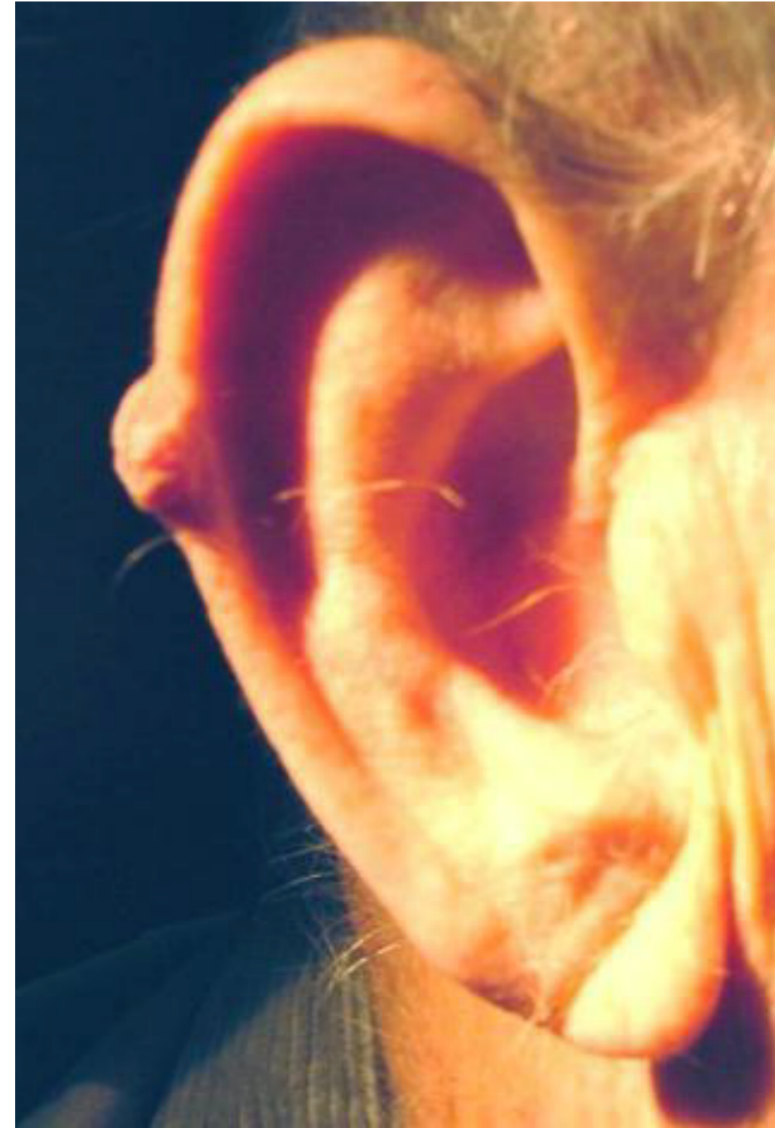
- Approximately 50% of hearing aid and ear mould remakes are due to poor impressions
- Repeat visits for remakes erode patient confidence
- Your time is the single highest overhead cost in your fittings
- Ten extra minutes repeating a poor impression may save you hours of time post fitting

Special cases and possible contraindications to impression taking

- Post-operative ears
- Perforated eardrums
- Stenosis
- Deep impressions for 'completely-in-the-canal' hearing aids etc.
- Impressions on small children
- Infections
- Excessive wax or foreign object on the canal
- Others

Abnormalities of the Abnormalities of the pinna

- Auricular cyst
 - Fluid filled piece of skin
 - Ask if they have seen GP
 - Make a note of this in patient records
 - Impression taking can go ahead



Abnormalities of the Abnormalities of the pinna

- Contact dermatitis
 - Allergic reaction
 - Should we take an impression?



Abnormalities of the external auditory meatus

- Epidermal cyst
 - Ask if they have had this checked, refer on if not
 - Do not take impression
 - Normally a cyst can stay in place and only needs removal when inflamed/irritated.
 - Due to this location, quality of impression will be compromised if not removed.



Abnormalities of the external auditory meatus

- Radical mastoidectomy
 - More common in older population
 - Always check if patient has had any ear surgery
 - Needs a lot of packing with otostops/surgical packing
 - Qualified, experienced audiologist



Abnormalities of the external auditory meatus

- Fungal infection
 - Impression contraindicated



Abnormalities of the external auditory meatus

- Swelling
 - After infection
 - Impression contraindicated



Abnormalities of the external auditory meatus

- Exostosis
 - Cold water swimming
 - Bony growths
 - Extreme case illustrated here



Abnormalities of the external auditory meatus

- Chronic infection
 - Smelly
 - Itchy
 - Must be treated



Abnormalities of the tympanic membrane

- Grommet
 - Can lie in ear canal for around 3 months after extrusion from tympanic membrane
 - Might be uncomfortable



Abnormalities of the tympanic membrane

- Central perforation
 - Needs checking before impression taking
 - Note tympanosclerosis on right



Age

- For small children an additional course/training is required
- Different anatomy
- More difficult population

Surgery

- Post operative ear impressions should generally be taken by a qualified audiologist
- Impressions should only be taken on post operative ears if cleared by ENT
- Packing may be necessary to make the ear safe to take impressions
- Healing ears will change shape and moulds may not fit
- Pressure can affect the healing ear

Foreign Bodies

- If a foreign body is present refer to ENT
- Removal of foreign bodies is usually done as a priority treatment due to the risk of infection
- Any attempt to place impression materials in the ear will lead to impaction of the foreign object and more difficult removal
- Possibility of eardrum perforation

Wax

(occluding vs non-occluding)



- If you cannot visualize the eardrum due to excessive wax or positioning of wax an impression should not be taken
- Impacted wax can cause the same problems as a foreign body
- Wax filling more than 25% of the cross section of the ear canal
- Remember: wax can hide serious problems

Taking an impression

- <https://www.youtube.com/watch?v=G07np2W1Hqw>
- Any errors?

Questions?

