SPAU332
Hearing Aids I

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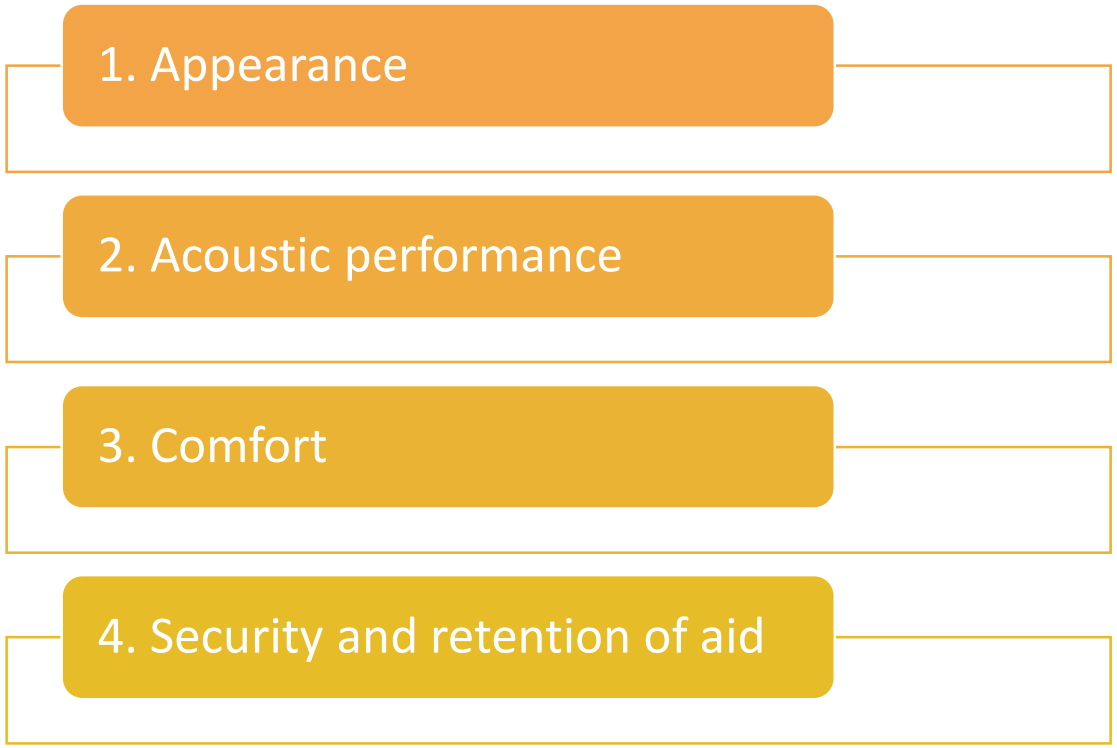
Earmoulds and coupling systems

Learning objectives: Select and justify the choice of ear coupling system for various hearing loss types and configurations.

Ear mould Styles

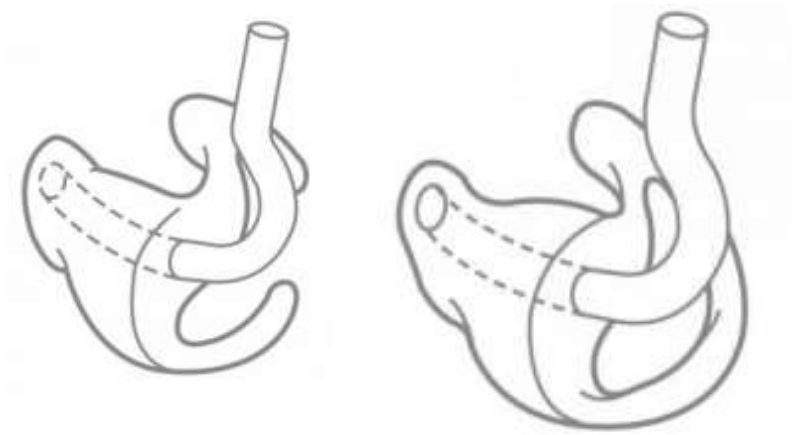
Moulds vary in the extent of the concha and ear canal that they fill and this will affect four aspects:



Earmould styles

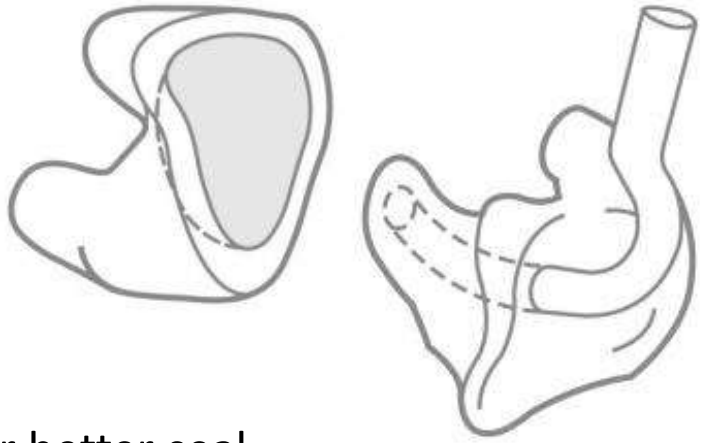
Earmould styles

- **Skeleton**



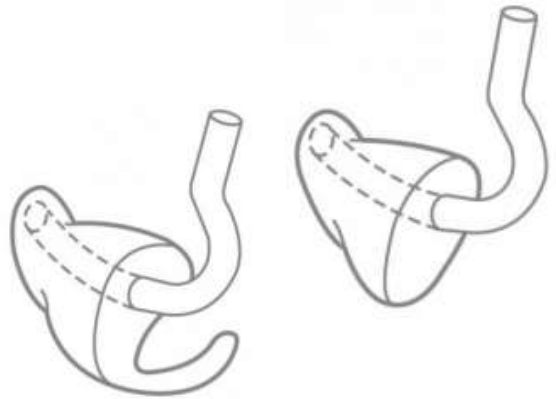
  - One of most common styles used with BTE hearing aids
  - Can be used with a wide range of hearing losses, from mild to severe
  - Can be easily modified to other styles e.g. semi-skeleton

Earmould styles



- **Shell**
  - Fills entire concha for better seal
  - Often used for severe to profound hearing losses and for younger children
  - Canal portion can be made thicker for a better seal or thinner for better cosmetics
  - Can be fitted with a snap ring instead of tubing e.g. for powered stethoscopes
  - Carved shell offers better sealing properties
  - Can be difficult to insert if tight fitting

Earmould styles



- **Canal mould**
  - Small, cosmetically appealing
  - Suitable for mild to moderate losses
  - Suitable for patients with a deformed pinna
  - Retention can be a problem
  - Can be modified with ‘concha lock’ to improve retention

Earmould styles

- Thin tube custom (For use with thin tube products (need to send tube with impression)
  - Prevent feedback
  - Improve retention
  - Increase gain

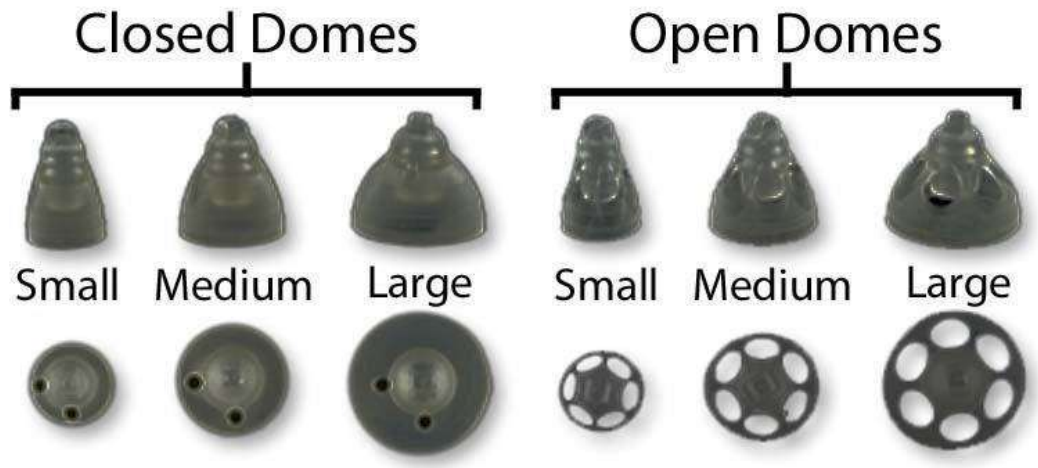
- RIC custom
  - For use with RIC products

Thin tube and dome systems

- Tube has very narrow diameter
- Manufacturer specific
- RIC style also available
- Can have problems with retention

Thin tube and dome systems

- Large array of products from all manufacturers
- Hook/tubing comes in different lengths



Receiver-in-the-ear systems

- Different dome/mould options
- Different wire lengths
- Different receivers sizes

LP
Low Power

MP
Medium Power

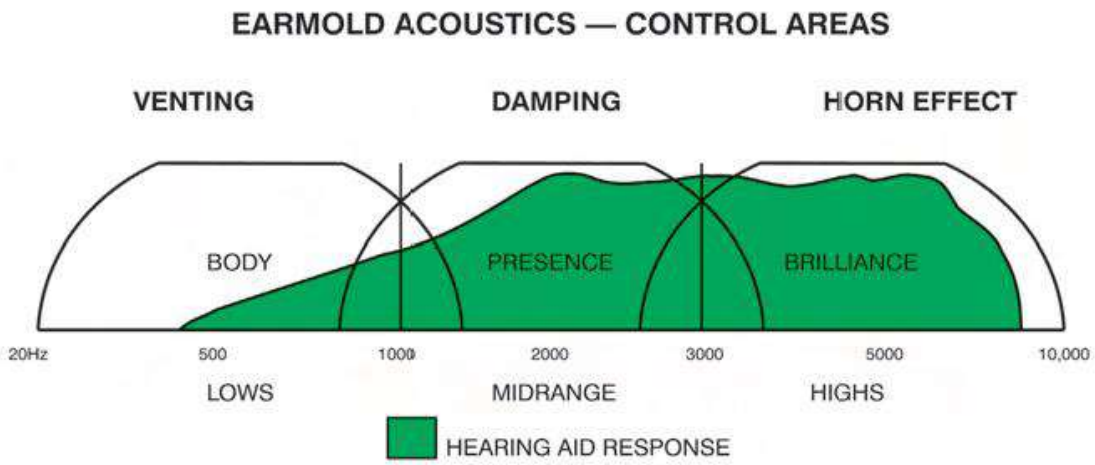
HP
High Power

UP
Ultra Power

Ear mould acoustics

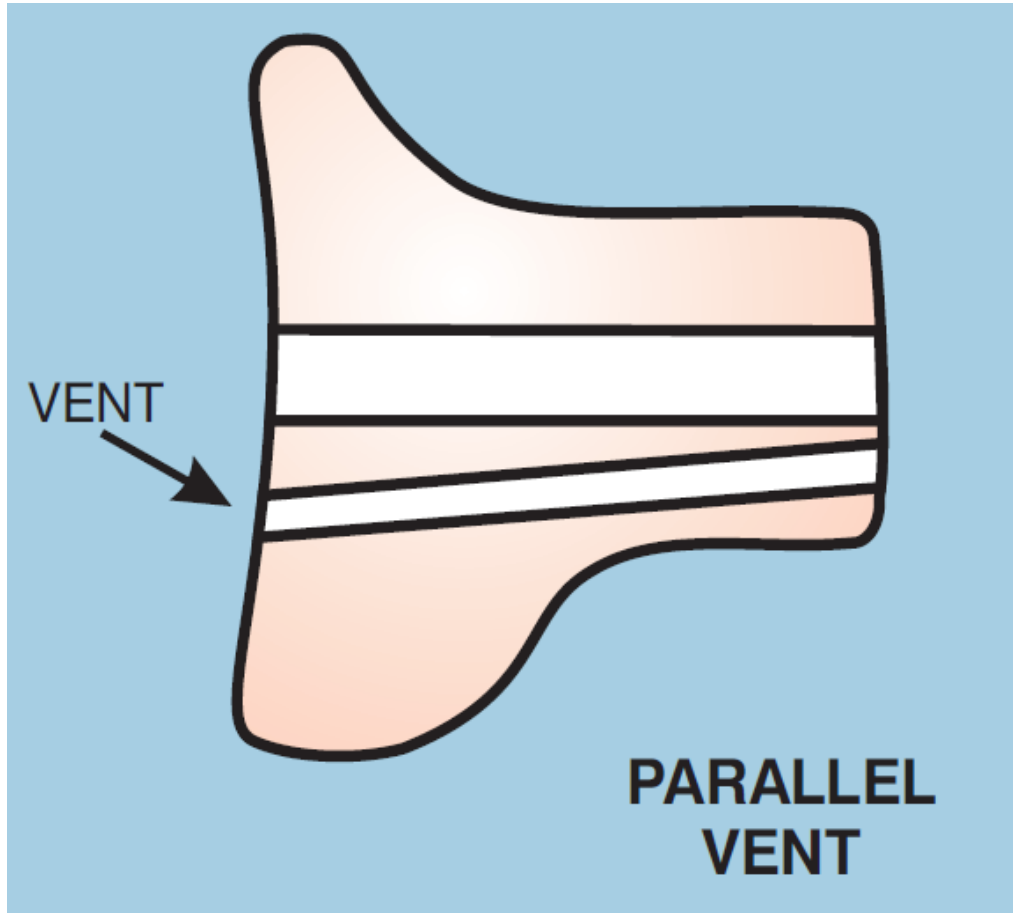
- The ear mould affects:
  - Comfort and appearance of the hearing aid
  - Acoustic response of the hearing aid when mounted on the ear
  - Self-perceived quality of the patient's voice
  - Likelihood of feedback

Ear mould acoustics



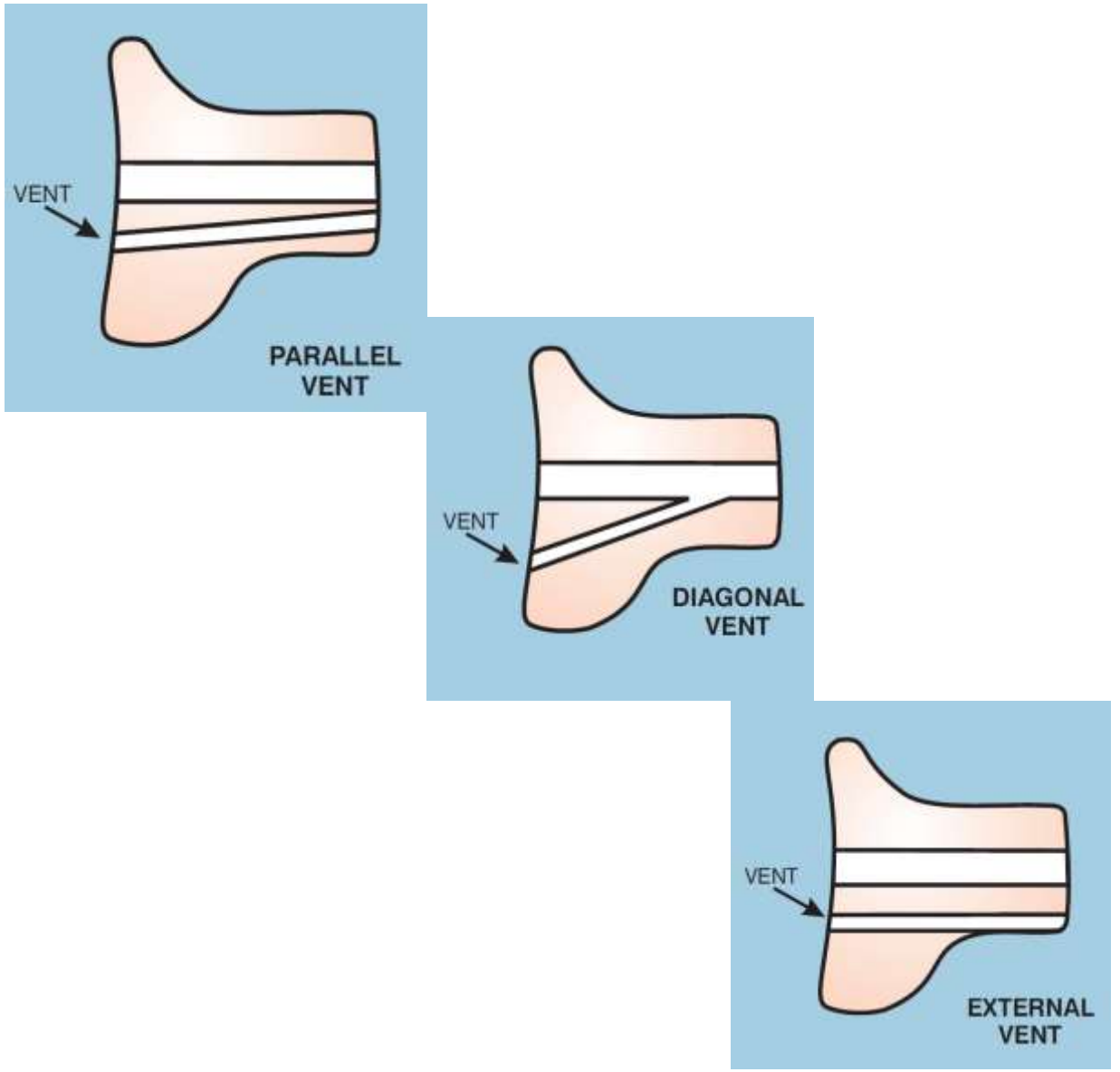
Venting

- Allows low-frequency signals to escape
- When hearing is normal in the low frequencies
- Allows low-frequency signals to enter unimpeded
- Sound quality may be improved if low-frequency sounds enter unprocessed by the hearing aid
- Allows low-frequency signals generated in the ear canal to escape
- Occlusion effect
- Allows aeration of the external ear
- Prevents moisture/condensation in the ear mould
- Allows pressure relief

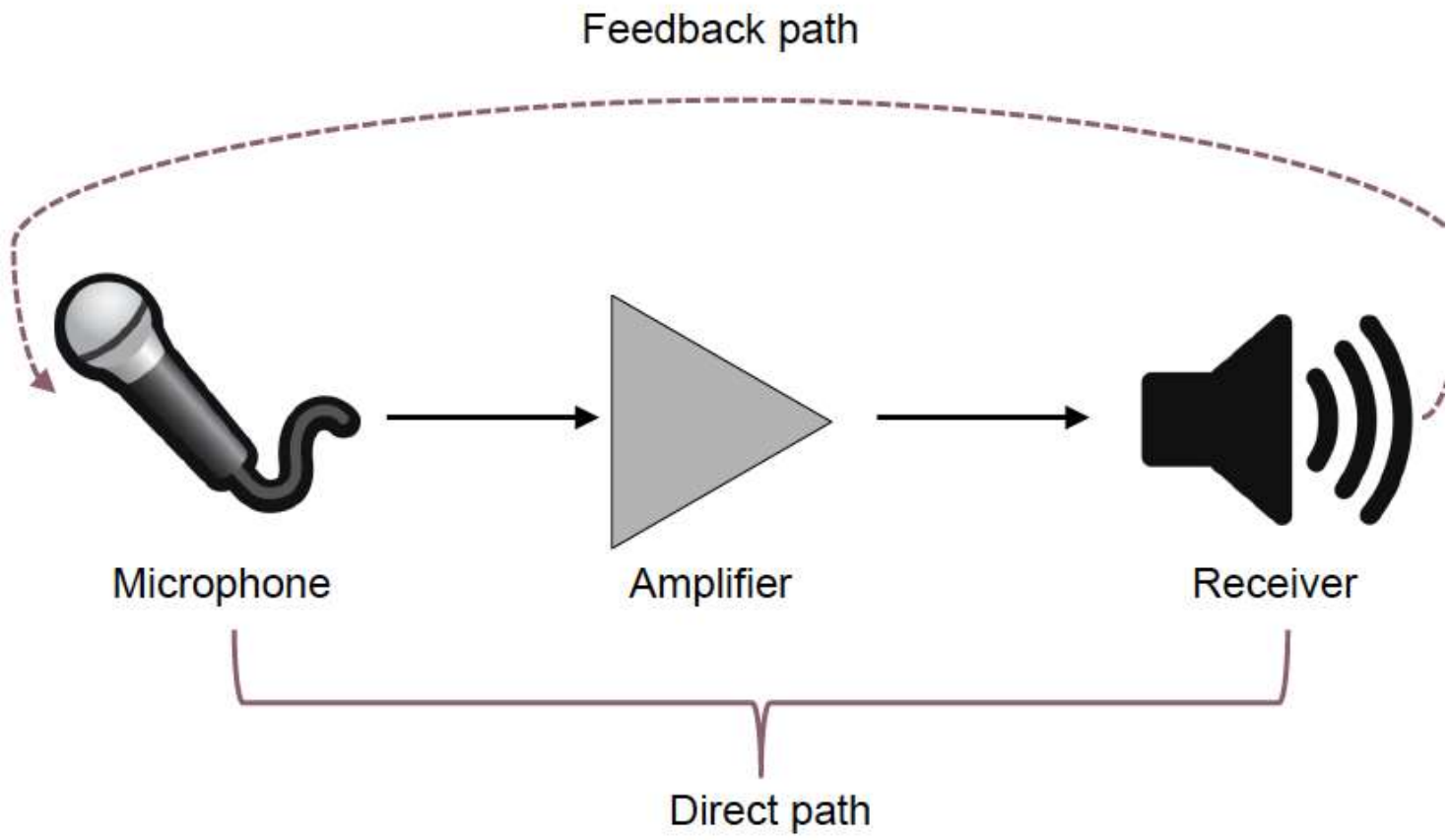


Venting

- Parallel vent
  - Most preferable
  - Comes in different sizes
- Diagonal vent
  - Used for small ear canals
  - May increase risk of feedback
- External vent
  - Preferable to diagonal vent as does not disturb bore

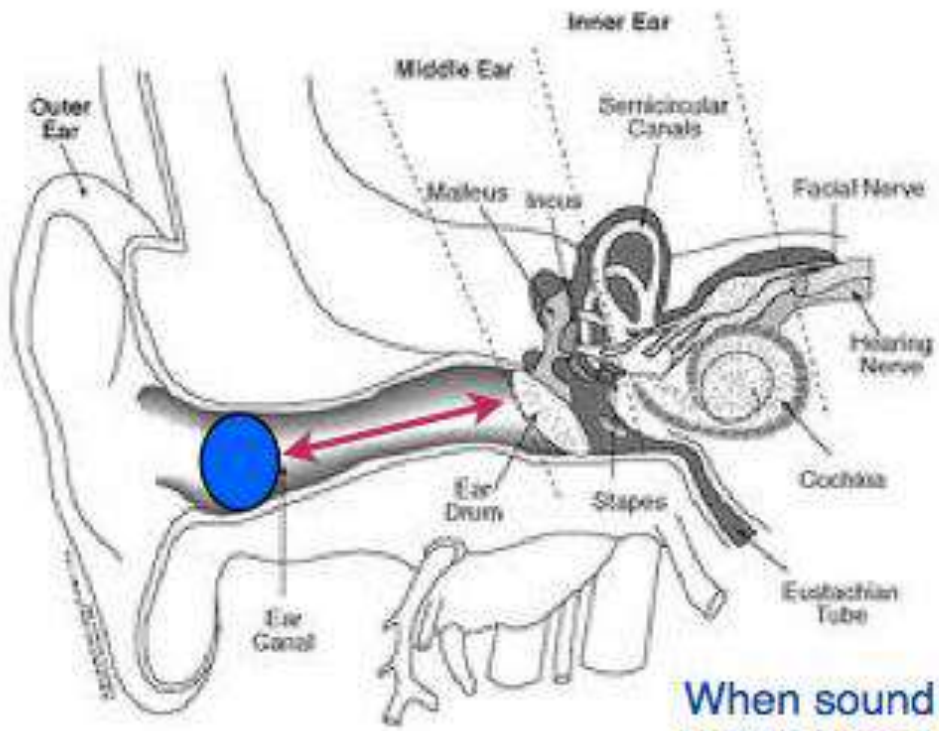


Effects of venting on feedback



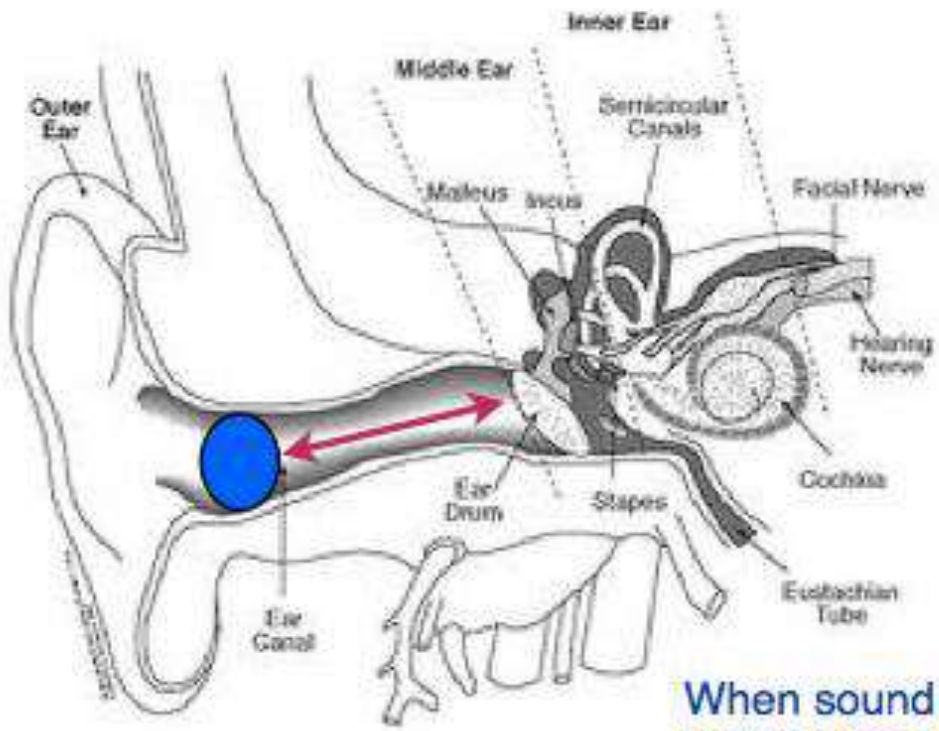
Occlusion

- The occlusion effect occurs when an object fills the outer portion of a person's ear canal
- Caused by bone-conducted sound vibrations reverberating off the earmould



Occlusion

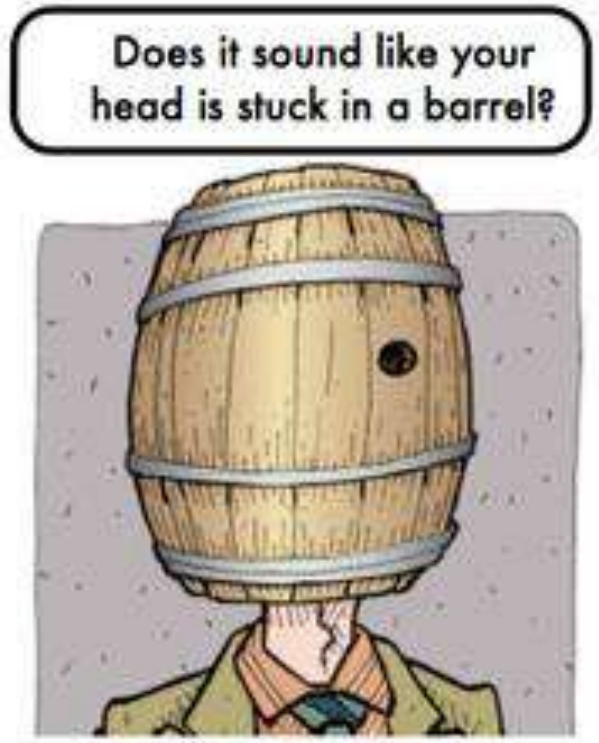
- When the ear canal is blocked, the vibrations are reflected back towards the eardrum
- Can boost low frequencies (below about 500 Hz) in the ear canal by 20 dB or more



When sound is trapped inside the ear canal, the sound trapped becomes amplified.

Occlusion

- When talking or chewing, these vibrations normally escape through an open ear canal
  - Most people are unaware of these sounds
- Hollow or booming echo-like perception of own voice



Occlusion

- Initial increase in earmould canal length elevates occlusion effect
- Extending past the second bend (acoustic seal area) significantly reduces occlusion effect

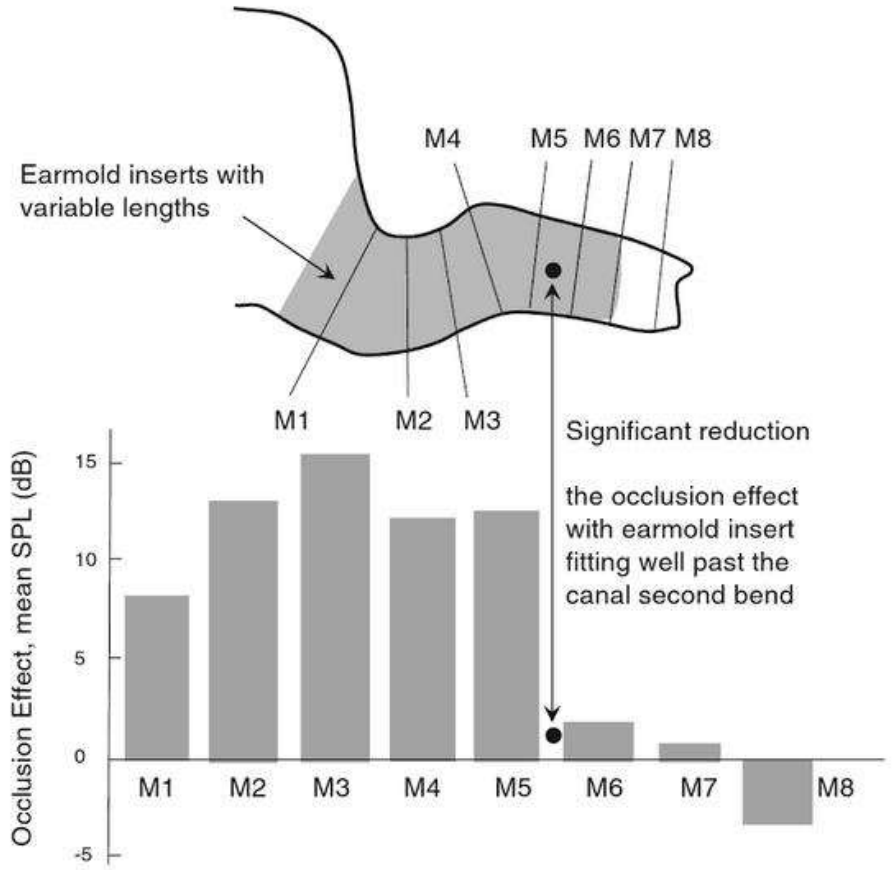


Figure 3–38. Variations in the occlusion effect depending on the insertion depth of an earmold.

Sandlin's Textbook of Hearing Aid Amplification, 3rd Edition

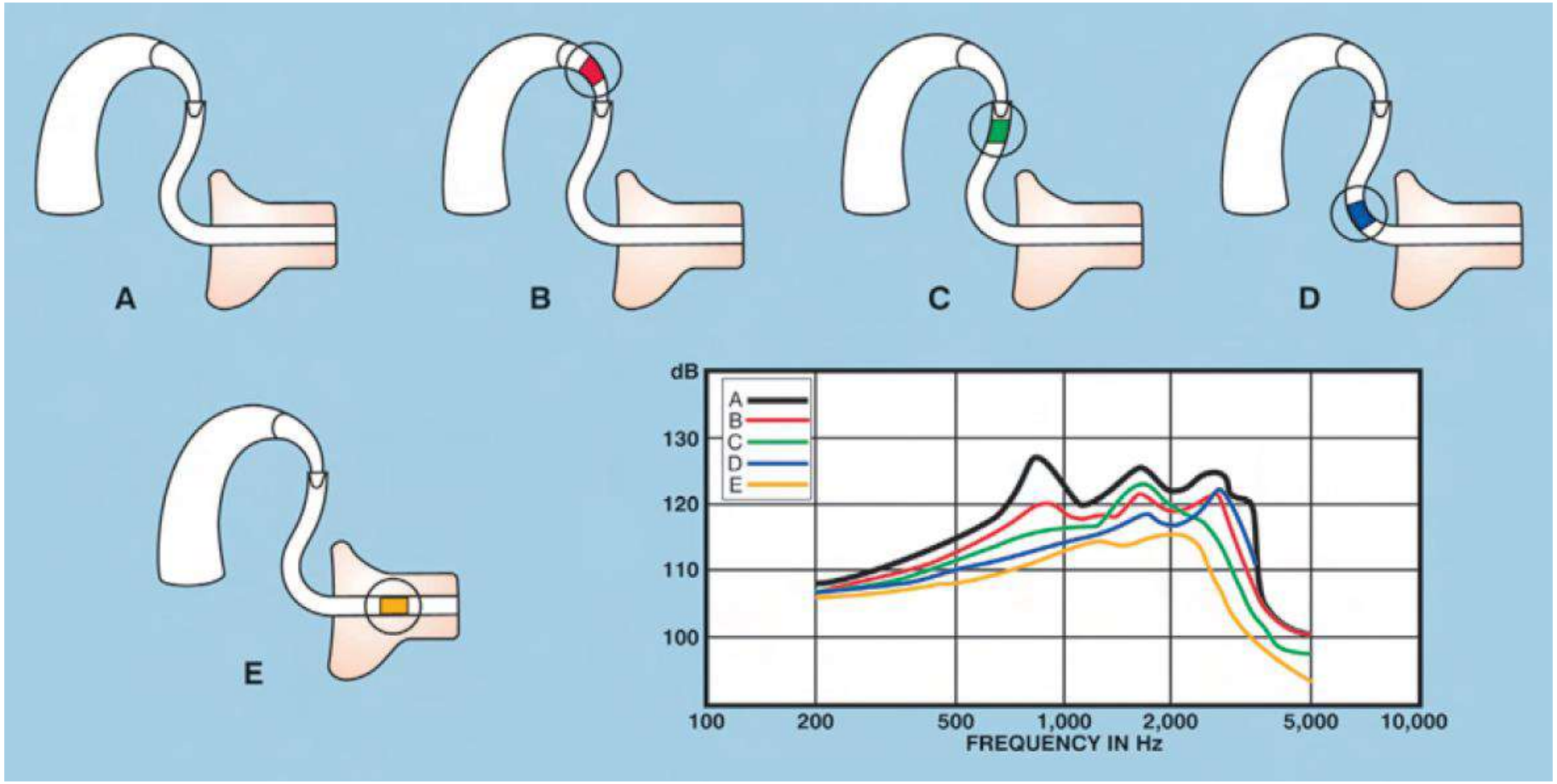
Occlusion and feedback

- https://vimeo.com/111455936

Damping

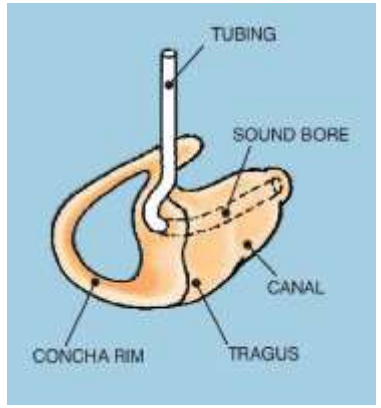
- Primarily affects frequencies between 750 and 3000 Hz
- Historically used to smooth out resonant peaks introduced by earhook or tubing
- Modern digital hearing aids use digital filtering to smooth out resonances
- If nonstandard tubing is used some undesirable resonances may remain – **reduced by damping**

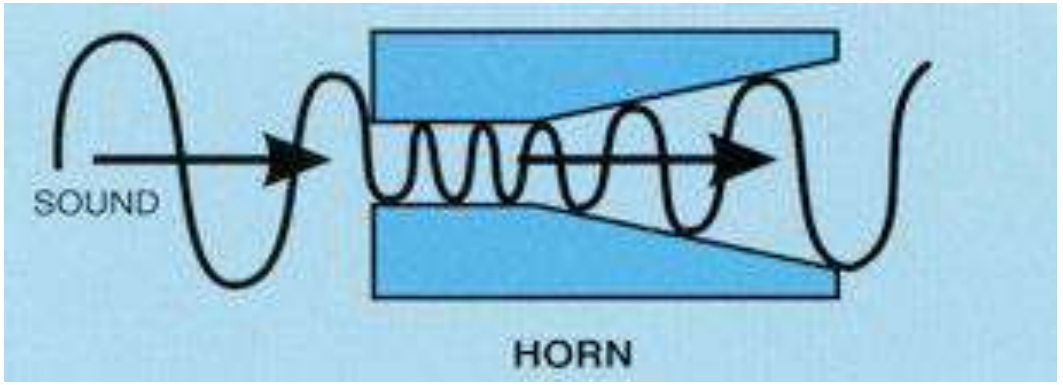
Damping

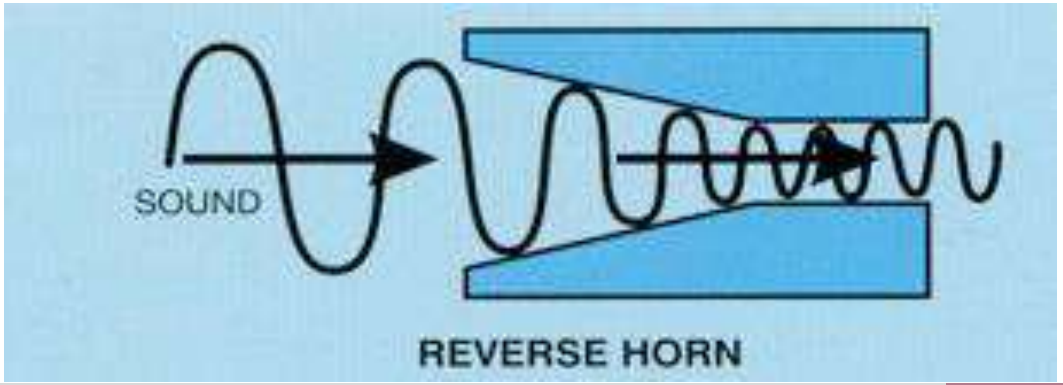


Horn effects

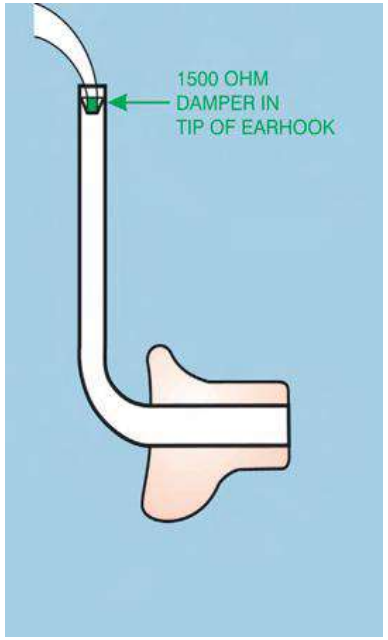
- Enlarging the sound bore enhances high frequencies
- Reducing the sound bore reduces high frequency components



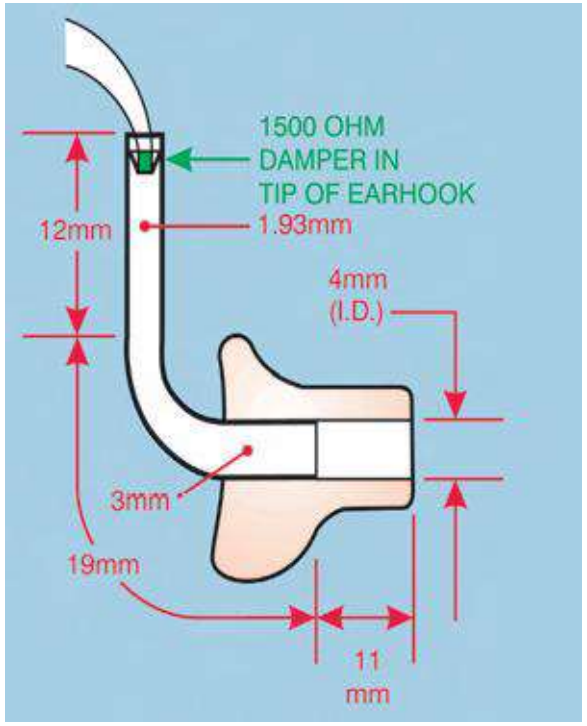




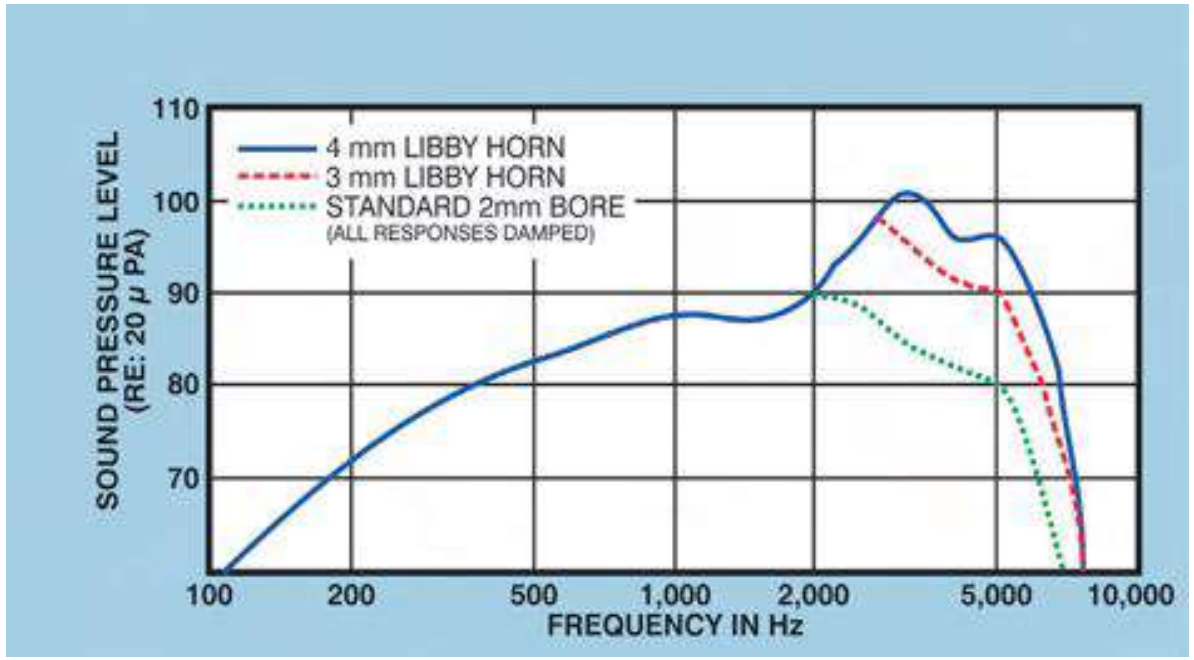
Horn effects



Standard bore



Libby horn

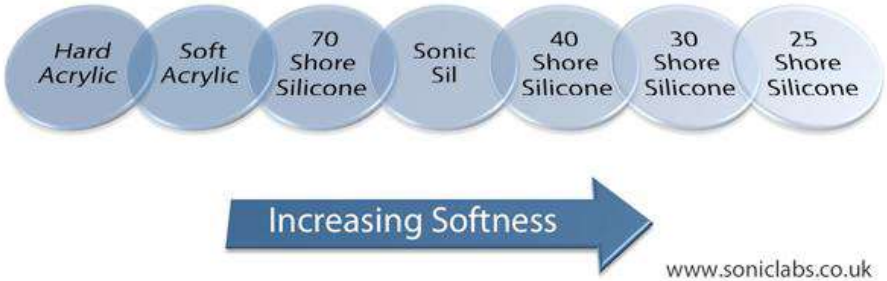


Earmould materials

- Three primary families of ear mould materials
  - Acrylic/lucite
  - Polyvinyl chloride (PVC)
  - Silicone

Earmould materials (Vary in their physical properties)

- Degree of softness
  - Described by shore value
  - The lower the shore value the softer the material
- Finishing characteristics
- Extent of shrinkage



Acrylic/ lucite

Positives	Negatives
Very hard so possible to make thin ridges	Will not bend or compress to get past narrow openings on insertion
Keeps shape without shrinking	More prone to feedback
Durable	Not usually recommended for children (danger of ear injury if struck)
Easy to modify	
Easy to insert/remove	
Fairly hypoallergenic	

Polyvinyl chloride

Positives	Negatives
Softer and more comfortable than acrylic	Not very durable
Appropriate for children	Soft nature makes modification more difficult than for acrylic
Appropriate for hearing losses in the moderate to severe range	Prone to discolouration over time
Although not as slick as acrylic, not as tacky as silicone therefore reasonably easy to insert	Problematic for people with vinyl allergies

Silicone

Positives	Negatives
Soft and tacky nature makes silicone ideal for severe to profound hearing losses	Soft nature makes modification more difficult than for acrylic
Appropriate for children	Soft and tacky nature makes it the most difficult to insert and remove
Fairly hypoallergenic	Can cause skin abrasions in patients with fragile skin
	Tubing adhesive does not bond well so may need mechanical tubing lock

Hard and soft acrylic combined

- Tip of ear mould is made of soft acrylic, rest of mould is made of hard acrylic
  - Cosmetic properties and ease of fitting of hard acrylic
  - Added comfort and acoustic sealing of soft acrylic
- Popular choice of mould

Ear-moulds

- In general, the greater the hearing loss, the larger the earmould needed
  - Accuracy of the earmould impression is as important as the style when thinking about maximum amplification before feedback
- Variety of canal lengths are possible
  - Longer canal lengths generally associated with less

Ear-moulds

- Tapering the end of the canal may make insertion easier but increases chance of feedback
- Avoid tacky materials for older patients with thin skin to prevent insertion abrasions
- Buffing and grinding works well for modifications of acrylic
- Scalpel or razor blade needed for minor modifications of soft materials, major modifications not possible

Case studies

- **Patient 1**
  - School teacher age 37. Fit and active. Keen cyclist. Mild to moderate sensorineural hearing loss.
- **Patient 2**
  - Retired, age 81. Arthritis giving dexterity problems. Moderate to severe sensorineural hearing loss.