Introduction

Sound Localization
- Localizing sounds in space (Duplex theory)
  - Interaural intensity difference (at high frequency)
  - Interaural time difference (at low frequency)
  - Minimum audible angle in normal hearing subjects: about 1 degree
- Binaural hearing

Unilateral Congenital Aural Atresia
- Congenital aural atresia (CAA): 1 in 10,000 to 20,000 births
  - Significant conductive hearing loss
  - Unilateral >> Bilateral (3:1)
- Unilateral conductive hearing loss in CAA
  - Major functional hearing deficit
  - Offer a unique opportunity to quantify any advantage of binaural hearing after correction of unilateral hearing loss
  - Little is known about the potential benefit of canaloplasty in binaural hearing and sound localization in unilateral CAA

Objective

To evaluate the binaural sound localization ability in unilateral CAA patients before and after canaloplasty

Materials and Methods

Subjects
- Patients with unilateral CAA + normal hearing in the opposite ear
  - Primary case
  - ≥ 12 months of postoperative follow-up

Study Design
- A prospective study
- August 2010 – August 2011
- Test battery
  - Preoperatively, 6 and 12 months postoperatively
    - Pure tone audiometry (PTA)
    - Speech perception (14 Qs)
    - Other Qualities of hearing (19 Qs)
    - Subjective hearing disability
      - Focusing on binaural hearing function
      - 3 domains
    - Sound localization test
      - Speech, Spatial, and Quality questionnaire (SSQ)

Results

Demographics
- 20 patients (17 Male, 3 Female) aged 10.2 – 19.9 YO (Mean 12.6 YO)
- Audiologist score 9 in all patients / Schuknectype C14 (70%), type B 6 (10%)

Hearing Results
- Air-Bone Gap (ABG): PreOp 53.5 ± 5.6 dB → PostOp (12mo) 27.0 ± 11.0 dB (p=0.001)
- PostOp 12mo ABG ≤ 30dB in 65% (13 / 20 patients)

Sound Localization
- Double-walled sound-delineating booth
  - 8 loudspeakers
  - 30° Intervals
  - Patient’s position: 1m from all speakers
  - Sound stimuli
    - Click train with 100μs pulse duration
    - Interval: 10ms

PreOp Interaural
- Localization: angle
- PreOp: 26.3 ± 23.0° ± 61° ± 9.8°
  - PostOp: 23.0 ± 12.3° ± 53° ± 15.2°

SSQ Questionnaire (Subjective Hearing Disability)
- Speech: 5.0 ± 2.7
  - Spatial: 59.8 ± 7.5
  - Quality: 90.3 ± 6.2
  - Total: 196.1 ± 11.0

Group Analysis

Results of sound localization tests at postop 12 mo according to the
- Hearing threshold (n=11)
- Hearing difference

Conclusion

Spatial hearing skills as measured with sound localization in terms of hit rate, error degree and right-left discrimination improved significantly 12 months following canaloplasty, perhaps because of the acquired binaural hearing ability.

The hit rate and localization (ipsilateral) score correlated with postoperative hearing air conduction threshold. This result demonstrates another potential benefit of canaloplasty in unilateral CAA patients.