Stapes surgery for patients with mixed hearing loss

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Aim

To determine the benefit of stapes surgery for otosclerosis in patients with mixed hearing loss and pre surgical average bone conduction threshold (BC) > 30dB.

Background

Otosclerosis classically causes a conductive hearing loss picture, with elevated air conduction (AC) thresholds and a raised air-bone gap (ABG). In some patients there is an apparent sensorineural component in their hearing loss, demonstrated by increased bone conduction (BC) thresholds. The Carhart effect in otosclerosis can give a false positive increase in BC thresholds across all frequencies but particularly at 2kHz. Current treatment options for otosclerosis patients are: hearing aid use, mixed stapes surgery with implanted hearing, aid and stapes surgery alone. Patients with BC of >30dB are traditionally not considered to be good candidates for stapes surgery. We therefore aimed to address two questions in studying this subgroup of patients with BC >30dB:

- 1) Is the high BC threshold a false positive result caused by the Carhart effect?
- 2) Are patients with BC threshold >30dB good candidates for stapes surgery to avoid hearing aid use?

Methods

Retrospective review of 121 patients with otosclerosis and average BC thresholds >30dB undergoing stapedotomy and SMART 360° prosthesis placement with a single surgeon (between July 2013 and July 2017).

3 Outcomes were assessed:

- 1) Audiometry results (pre and post surgery for 121 patients)
- 2) Quality of life using the Glasgow Benefit Inventory (GBI) for 87 of these patients
- 3) Hours of hearing aid use pre and post surgery for 87 patients

Life Quality Results

- 84% of patients had a significant increase in their GBI scale (>30)
- 5 (5.7%) patients saw a decrease in their QoL points

Hours of hearing aid use Results

- 49 (56%) patients went from using a hearing aid to not needing one
- 2 patients went from never needing a hearing aid, to using one

Audiometry Results

- Air Bone Gap
 - Improved in 95.04% (n=115) of patients
 - Significantly closed (to <10dB) in 79.34% (n=96) of patients. Average ABG closure was 20.8dB.
- Air conduction - Overclosure
 - 57.02% (n=69) of patients achieved a post-surgical AC better than their pre-surgical BC (Overclosed). In theory, this would have been impossible, unless the pre-surgical BC was falsely increased, due to the Carhart effect.
 - The highest percentage of overclosure (67.7%, n=82) was seen at 2kHz, which aligns with the Carhart notch.
- Bone conduction
 - 72.5% of patients had an improvement in their BC
 - 64% improved their BC thresholds to less than 30dB after surgery - unexpected improvement in sensorineural hearing

Frequency and dB	Average	0.5kHz	1kHz	2kHz	3kHz	4kHz
post BC	28.2	22.9	24.8	34.3	31.0	28.6
(post-pre BC)	-6	-4	-6	-9	-6	-12
pre BC	34.3	26.7	31.1	42.9	36.7	30.2
(postAC-preBC)	0	+5	1	-6	0	+11
post AC	34.3	31.8	32.1	36.6	36.7	40.8
(post - pre AC)	-27	-33	-30	-23	-23	-21
pre AC	61.5	64.6	62.4	59.4	59.4	62.1

Conclusion

When assessing suitability for surgery, surgeons should consider that pre-operative bone conduction thresholds may be a poor indicator of the true cochlear reserve. As a result there is a potential for improvement in both air and bone conduction thresholds in patients who would otherwise would have been classified as poor candidates for stapes surgery. We would therefore recommend that a stapedotomy is carried out before an implanted hearing aid is fitted in otosclerosis patients with apparent poor cochlear reserve.