Evidence Summary

Case Series

Van de Heyning and colleagues reported on their experience with 21 patients who underwent cochlear implantation for severe intractable tinnitus in the context of single sided deafness (1). The CI resulted in a significant reduction in tinnitus loudness up to 2 years after implantation. With the device deactivated, tinnitus loudness was still reduced.

Firszt et al described the outcomes of cochlear implantation in 3 patients with unilateral deafness (2). The patients obtained open-set speech recognition, improved localization, improved word recognition in noise, and improved perception of their ability to hear in everyday life.

Frisch et al outlined short term outcomes for 12 patients with single sided deafness (3). Patients reported a high level of satisfaction. Early audiometric data indicate that these patients scored similarly to standard implant users in the CI only condition. In addition, they showed substantial improvement in noise since preoperative testing.

Härkönen et al examined the impact of cochlear implantation on quality of life, quality of hearing and working performance in 7 patients with single sided deafness (4). The QoL, QoH, sound localization, and speech perception in noise improved significantly after CI surgery. Communication with co-workers became easier, and patients were less fatigued after the working day.

Friedman et al described experience with 12 adult and 4 paediatric patients with unilateral severe to profound hearing loss (5). There was significant improvement in speech perception performance in quiet and in noise after implantation. Performance may have depended on factors including length of hearing loss, age at implantation, and device usage.

Mertens et al reported on long term (3-10 years) follow up for 23 patients with UHL (6). All patients still wore their CI seven days a week. It appeared that in all subjects but one CI switch-on is the first act when rising and CI switch-off is the last act before bedtime. In the SSD group, tinnitus suppression is still the primary benefit reported (83%). This research group also demonstrated that the unilateral tinnitus can significantly decrease speech reception in noise in the non-tinnitus ear (7).

Rahne et al demonstrated significant benefits of cochlear implantation in 21 patients with SSD (8). Mean speech recognition scores increased and there were significant improvements of the speech reception threshold in different speech and noise configurations.

Arndt et al reported on outcomes for 45 patients with single sided deafness (9). This report presents evidence of successful binaural rehabilitation with CI in a relatively large patient cohort and the advantages over (Bi)CROS and Bone Conduction in smaller subgroups.

Dillon et al reported on a clinical trial including 20 participants with unilateral hearing loss treated with cochlear implantation (10). Participants experienced a significant improvement in localization in the cochlear implant and natural hearing condition at the 1-month interval as compared with the preoperative natural hearing alone condition. Localization continued to improve through the 6-month interval. Binaural acclimatization in cochlear implant users with unilateral hearing loss can progress rapidly, with marked improvements in performance observed after only 1 month of listening experience.

Galvin et al reported on an FDA approved prospective study of cochlear implantation in 12 patients with severe to profound unilateral hearing loss and normal hearing in the other ear (11). Significant

benefits were observed for tinnitus severity, localization, speech understanding, and quality of life. The degree and time course of cochlear implant benefit depended on the outcome measure and the reference point. Relative to binaural baseline performance, significant and immediate (1 month postactivation) cochlear implant benefits were observed for tinnitus severity and speech performance in noise, but localization did not significantly improve until 6 months post-activation; questionnaire data showed significant improvement in quality of life 6 months post-activation.

Sullivan et al described long term outcomes for 60 patients with profound hearing loss in one ear and normal to near-normal hearing in the other ear who underwent cochlear implantation (12). Subjects had meaningful improvement in word understanding, and sound localization tended to gradually improve over time. Binaural benefit analysis showed significant improvement with head shadow effect, which likely provided ease of listening.

Häußler and colleagues reported on tinnitus distress, health-related quality of life (HRQoL) and psychological comorbidities in 20 single-sided deaf patients treated with cochlear implantation (13,14). In addition to positive effects on HRQoL, tinnitus distress, and psychological comorbidities the cochlear implant led to benefits for hearing improvement, particularly in noise and for directional hearing.

Marx et al conducted a multicenter prospective study in 7 tertiary university hospitals including 155 patients with single-sided deafness or asymmetric hearing loss (15). Patients self-selected for CI, CROS or BAHS. Cochlear implantation led to significant improvements in quality of life in SSD and AHL patients, particularly in subjects with associated severe tinnitus.

Randomised Controlled Trials

Peters et al reported on short-term outcomes for the CINGLE randomized controlled trial- cochlear implantation for single-sided deafness compared to bone conduction devices and contralateral routing of sound hearing aids (16). Adult SSD patients (n=120) were randomized into one of three groups: cochlear implant; trial period of 'first BCD, then CROS'; trial period of 'first CROS, then BCD'. The number of patients per group after allocation was: CI (n=28), BCD (n=25), CROS (n=34), and No treatment (n=26). For the primary outcome of speech perception in noise, the CI group performed significantly better than the other groups. In the speech directed to the better ear and noise to poor ear condition, BCD and CROS groups performed worse compared to baseline, whereas the cochlear implant group improved. The cochlear implant group were the only group to experience improved sound localization and tinnitus burden.

Systematic Reviews/Health Technology Assessments

Arts et al summarized all available experience of using cochlear implantation as a treatment for tinnitus in single sided deafness up to 2012 (17). Among 89 patients with single sided deafness, the majority observed tinnitus improvement after cochlear implantation.

Tokita et al reviewed studies and case reports of cochlear implantation in SSD up to 2014 (18). They reported that studies show improvements in speech understanding, sound localization, and tinnitus. On the basis of these encouraging early results and the unique ability to restore binaural sound processing, a growing number of centers offer cochlear implants as treatment for SSD.

Oh et al reviewed 50 studies including 674 SSD patients and concluded that cochlear implantation in adults with SSD results in significant improvements in speech perception, tinnitus control, sound localization, and quality of life (19).

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A Canadian health technology assessment examined safety, effectiveness, and cost-effectiveness of surgically implanted hearing devices and what the budget impact of publicly funding these devices would be (20). The best available evidence showed that cochlear implants helped people with single-sided deafness to hear better and improved their hearing-specific quality of life. For people with single-sided deafness, cochlear implants may be cost-effective compared with no hearing aids or no implant. The estimated cost to publicly fund cochlear implants for people in Ontario with single-sided deafness would be $2.8 million to $3.6 million over the next 5 years. People with hearing loss who were interviewed reported believing that implantable devices are better than standard hearing aids even if the implants have some limitations. Some people experienced high out-of-pocket costs to get or maintain their device.

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