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Does Cochlear Implantation Improve Cognitive Function?

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BACKGROUND

By 2050, the proportion of people over the age of 60 years will double. Coincident with age-related declines in hearing are declines in cognitive functions. Moreover, cognitive losses beyond those associated with normal aging are found in 20% of adults over 70 years of age, with frank dementia in 5% of patients between 70 and 80 years of age and 37% of patients over 90 years of age.

Multiple studies have begun to demonstrate an association of SNHL with cognitive declines. In fact, SNHL is now considered the largest modifiable risk factor in midlife for later development of dementia. The impact of intervention for SNHL, however, either through hearing aids (HAs) or cochlear implants (CIs) remains unclear. Although there is mounting evidence that HAs result in improved cognitive function in this population, less research has been done in adults receiving CIs. This Triological Society Best Practice statement summarizes what is known regarding the impact of CIs on cognitive function.

LITERATURE REVIEW

Until recently, there have been limited data focused on cognitive outcomes following CI. In 2015, Miller et al. published a systematic review and found only three studies that included patients >65 years who had undergone cognitive testing.1 All studies were published before 1997, and a total of only 89 patients were included (59 of whom had single-channel devices). Some degree of cognitive improvement was suggested in two of the three studies.

Also in 2015, Mosnier et al. published a multicenter, longitudinal study of 93 CI recipients >65 years old who underwent cognitive testing preoperatively as well as 6- and 12-months post-CI.2 Functions tested included episodic memory, visuospatial abilities, attention span, processing speed, mental flexibility, and executive function. The authors found that the percent of patients with no abnormal tests increased from 25% to 40% following CI. Additionally, the number of patients with two to three abnormal tests decreased from 44% to 22%. Improvements were seen at 6 months in episodic memory, processing speed, mental flexibility, and executive function—with further improvements noted at 12 months in processing speed, mental flexibility, executive function, and attention. Notably, 80% of patients with the poorest pre-CI cognitive function showed improvement after CI. Importantly, however, all patients received post-CI speech therapy rehabilitation, which may have confounded results.

A 2016 study by Cosetti et al. looked at longer-term cognitive outcomes, including working memory function.3 This study retrospectively evaluated seven elderly CI recipients ≥65 years old who received preoperative and postoperative neurocognitive testing without post-CI rehabilitation. Domains tested included IQ, memory, verbal fluency, attention, learning, mental flexibility, and motor-based processing speeds. Forty-three percent of patients showed improvement up to 4 years following surgery, with the greatest gains clustered into the domains of verbal function and memory.

In 2017, Jayakody et al. conducted a prospective, case-control study comparing 16 adult CI recipients to 23 adult CI candidates awaiting surgery in the Australian national health care system.4 Patients were assessed at 6 and 12 months, the typical waiting period for CI in Australia. Neurocognitive testing revealed significant differences at 6 months, favoring CI recipients in attention, processing speed, and working memory. At 12 months, further gains were seen in working memory, general memory, and executive function. This study provided prospective, controlled, observational support linking CI to improvement in multiple key cognitive functions.

In one of the largest prospective studies to date on post-CI neurocognitive function, Völter et al. assessed 60 adult patients preoperatively and then reassessed...
33 patients at 6 months and 20 patients at 12 months. Their computer-based test battery evaluated attention; short-term, working, and long-term memory; processing speed; executive function; and inhibitory ability. At 6 months, improvements were noted in attention, inhibitory ability, and both working and short-term memory. At 12 months, further gains were noted in working, short-term, and long-term memory as well as in attention. Like Mosnier et al.’s study, patients with poorer preoperative performance demonstrated the greatest improvement, especially if over 65 years of age.

**BEST PRACTICE**

Although not wholly conclusive, there appear to be consistently demonstrated improvements in attention, episodic, and working memory, as well as processing speed in new CI users, even after as little as 6 months experience with their devices (Table I). Nonetheless, these studies still suffer from some important limitations. First, the long-term benefits to cognition are unclear, with most studies limited to repeat testing at 6 or 12 months after implantation. Second, many patients receive some degree of therapeutic “rehabilitation” after CI beyond simple restoration of audibility through an implant, such as through clinician-guided auditory training, computerized training programs, or audiobooks. Third, many of these studies did not include a control group, with the exception of the Jayakody et al. study. Fourth, inappropriate utilization of measures that are delivered auditorily (or audiovisually) by a neuropsychologist may overestimate the severity of cognitive dysfunction by patients with severe hearing loss, thus falsely inflating any improvements demonstrated after audibility is restored through a CI. Fifth, none of the studies to date have included patients with clinically diagnosed cognitive impairment or dementia, so it is unclear if CI can impact cognitive functioning in patients with baseline impairment. Finally, and perhaps most importantly, the mechanisms underlying any changes in cognitive functions because of CI remain poorly defined and underexplored.

**LEVEL OF EVIDENCE**

The described studies provide convincing—but only level 3 to 4—evidence for a positive impact of CI on cognitive functions.

**BIBLIOGRAPHY**