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Editorial

Future Directions of Optical Coherence Tomography in Otology: A Morphological and Functional Approach

Nam Hyun Cho[1,2] · Jeong Hun Jang[3]

[1]*Department of Otolaryngology and Head-Neck Surgery, Harvard Medical School, Boston, MA;* [2]*Eaton-Peabody Laboratories, Massachusetts Eye and Ear, Boston, MA, USA;* [3]*Department of Otolaryngology, Ajou University School of Medicine, Suwon, Korea*

Optical coherence tomography (OCT) is a real-time optical imaging modality that enables tomographic imaging at the submicron scale. Basic research into applications of OCT systems in the field of otology has been conducted. For instance, Oh et al. [1] recently reported that OCT provided noninvasive, nondestructive two-dimensional cross-sectional and three-dimensional volumetric images of middle-ear and inner ear structures in rodents. Anatomical depth-resolved imaging has shown promising potential for morphological measurements of the middle and inner ear in chinchillas [2] and mice with blast trauma [3]. Moreover, OCT has demonstrated its capability as a functional analytical tool by characterizing the vibration of middle and inner ear structures using the Doppler principle without contrast labeling to identify fluid, cellular structures, and bone [4]. Interestingly, Eustachian tube status and stent position were evaluated noninvasively using an intraluminal three-dimensional OCT catheter in sheep cadaver heads [5].

Recently, various studies have attempted to apply OCT to the clinical field. Structural changes of the middle ear in otitis media were investigated using a hand-held OCT otoscope probe [6]. General trends in the thickness distribution of the human tympanic membrane (TM) were suggested based on *in vivo* thickness mapping by a mosaicking approach [7]. Additionally, a surgical microscope integrated with OCT was developed and its usefulness for surgical decision-making during tympanomastoidectomy was verified [8]. Furthermore, *in vivo* middle ear vibrations were measured using a combined microscope at the picometer scale in an outpatient clinic [9]. A major obstacle for OCT in clinical applications is its shallow penetration depth and field of view smaller than human middle ear structures such as the TM and ossicles. To overcome this hurdle, long-range wide-field swept-source OCT vibrometry was developed and validated for real-time imaging of normal middle ear structures and stapes fixation in living patients [10].

Morphological changes of the cochlea can be visualized by micro-OCT technology in addition to histological slide/labeling methods, such as confocal and two-photon microscopy. Since these techniques are used for post-mortem analyses, the structural properties of the cochlea may be changed and distorted by the embedding chemical solutions. Furthermore, specimen preparation and the imaging process could be time-consuming. Micro-OCT technology requires no contrast agent and can be used to image entire structures within its detection field near-instantaneously. Micro-OCT images of guinea pig intracochlear anatomy *in situ* were generated to resolve the microanatomy at a cellular level [11].

OCT is already a useful imaging technique in basic research in otology. Although OCT is known to be difficult to apply in clinical otology due to several drawbacks, it has many advantages that may even surpass its limitations. It is important to pioneer this niche with original ideas such as an intraluminal OCT catheter for Eustachian tube evaluation, a functional hand-held OCT otoscope with vibrometry, a surgical microscope integrated with OCT, and micro-OCT for *in vivo* imaging. Ultimately, the development of a unique and accessible OCT device helpful for the accurate diagnosis and treatment of diseases could be a survival strategy of itself in otologic field.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ORCID

Nam Hyun Cho https://orcid.org/0000-0002-7188-0565
Jeong Hun Jang https://orcid.org/0000-0003-1707-5714

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