Contrast-enhanced micro-computed tomography imaging of the rodent and human inner ear.

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Introduction

Imaging of the inner ear is critical to better understand changes on hearing function due to pathologies such as hearing loss. Synchrotron radiation-based μCT imaging provides high resolution and contrast, allowing researchers to visualize soft tissue structures in the inner ear [1, 2]. Unfortunately, access to a synchrotron-based imaging system is often limited. Laboratory benchtop μCT imaging systems can provide high-resolution images of hard tissues, but not soft tissues. In this study we tested the ability of a μCT system and Iodine Potassium Iodine (IKI) staining to provide improved images of both soft and hard tissues in the intact murine and human cochleae.

Methods

A human temporal bone was explanted right after death from a donor (female, 62 yo) and the bullae of a Wistar rat (14 do) were harvested after death. Fixation was carried out in 10% buffered formaldehyde for 1 week and the inner ear was isolated [3]. Both samples were stained with 50% IKI/Buffer saline solution (0.1 Normal/0.05 M, Fisher Scientific, USA) and μCT-scanned (1172, SkyScan, Belgium) 1, 2, 3, 5 and 7 days after incubation in IKI to determine the time required for the contrast agent to diffuse and reach equilibrium within the tissues. Scanning was performed at 100 kV and 100 μA, using a 0.5 mm thick aluminum filter. Images of the inner ear were acquired at 3-μm and 2.1-μm resolution for the human and the rat cochleae respectively.

Results

Cochlea bone microarchitecture and soft tissues morphology were shown in great detail when samples were treated with IKI and imaged with μCT at high-resolution. The shapes of Reissner's, auditory nerve, basilar and tectorial membranes and the contour of the Organ of Corti (OC) can be extracted using this technique. However, no feature of the OC such as hair, pillar and phalangeal cells can be clearly observed. Five days incubation was considered the most appropriate for a successful imaging of the tissues in the human and rat cochlea.

Discussion

In this study we tested the ability of IKI to provide increased image contrast when compared to the X-ray absorption of soft tissues in the human and rodent inner ear. The presented data demonstrated that a contrast-enhanced μCT imaging approach can be used for the 3D imaging of soft tissues in the human and rodent inner ears to investigate 3D changes of soft tissues due to hearing pathologies in human and the rodent inner ear samples.

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