

TOWARDS THE IN-VIVO AUTOMATED ASSESSMENT OF NASAL CILIA MOTILITY

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Introduction

Cilia motility is an important diagnostic feature for various nasal diseases, both of acquired and genetic origin.

So far this assessment has been performed ex-vivo in nasal samples. Sampling is invasive and may damage cilia, and ex-vivo measurements may not always reflect the in-vivo cilia function.

In this work we investigated the possibility of assessing cilia motility in vivo in humans with a preliminary study using confocal micro-endoscopy.

Materials and methods

We used the high-power laser confocal endoscope developed by Mauna Kea Technology (MKT). This device has a 1µm spatial resolution and a temporal resolution varying between 8 and 90 Hz.

Ex-vivo pig trachea samples and human nasal biopsy samples were labelled with fluorescent marker Octadecyl Rhodamine B Chloride (R18). Beating cilia were easily identified allowing the acquisition of 40 videos ready for analysis. Using in-house software that estimates frequencies based on luminance variation in a small window and FFT analysis, we evaluated cilia and compared the beat frequency with ground truth.

Results

We validated our estimations on all sequences acquired between 30 and 90Hz. Videos acquired at less than 30Hz did not offer sufficient temporal resolution. We only observed occasional errors when the software identified a harmonic oscillation instead of the fundamental frequency.

Conclusion

The MKT confocal endoscope allowed us to visualize ex-vivo beating cilia and to measure beat frequencies. Fluorescent dye approved for human use will be required for future in-vivo experiments. This constitutes a first feasibility step in-vivo cilia motility evaluation.