Paper Presentation

Robotically Assisted Cochlear Imaging

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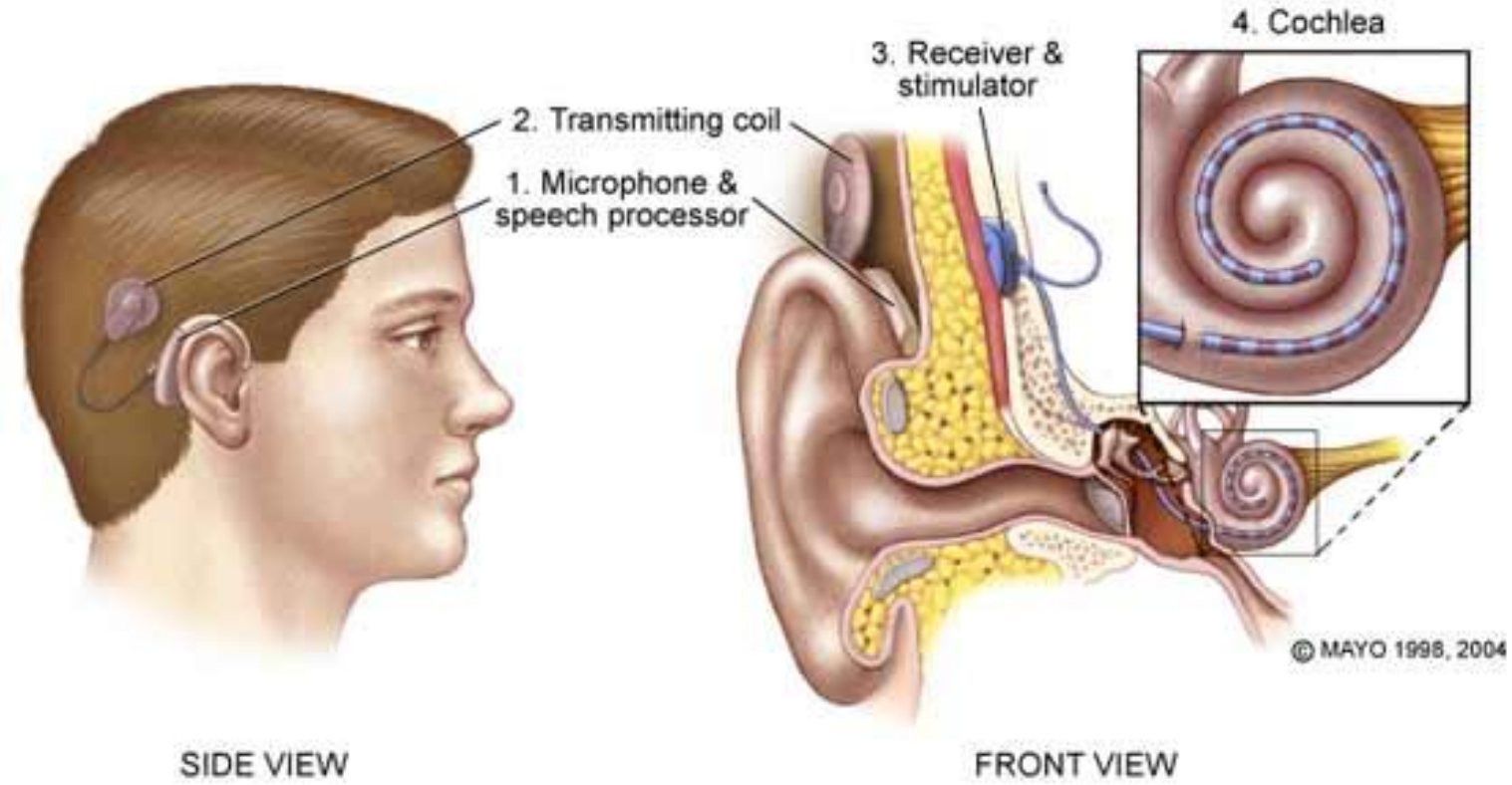
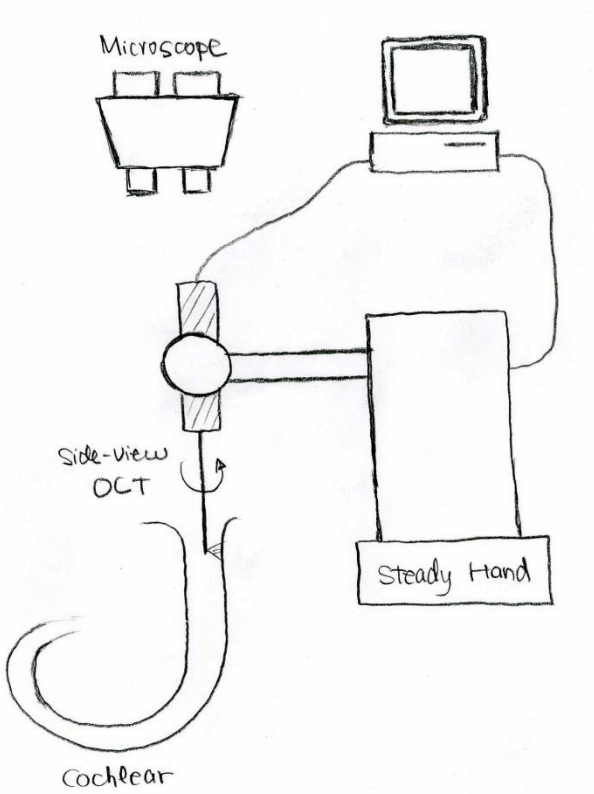
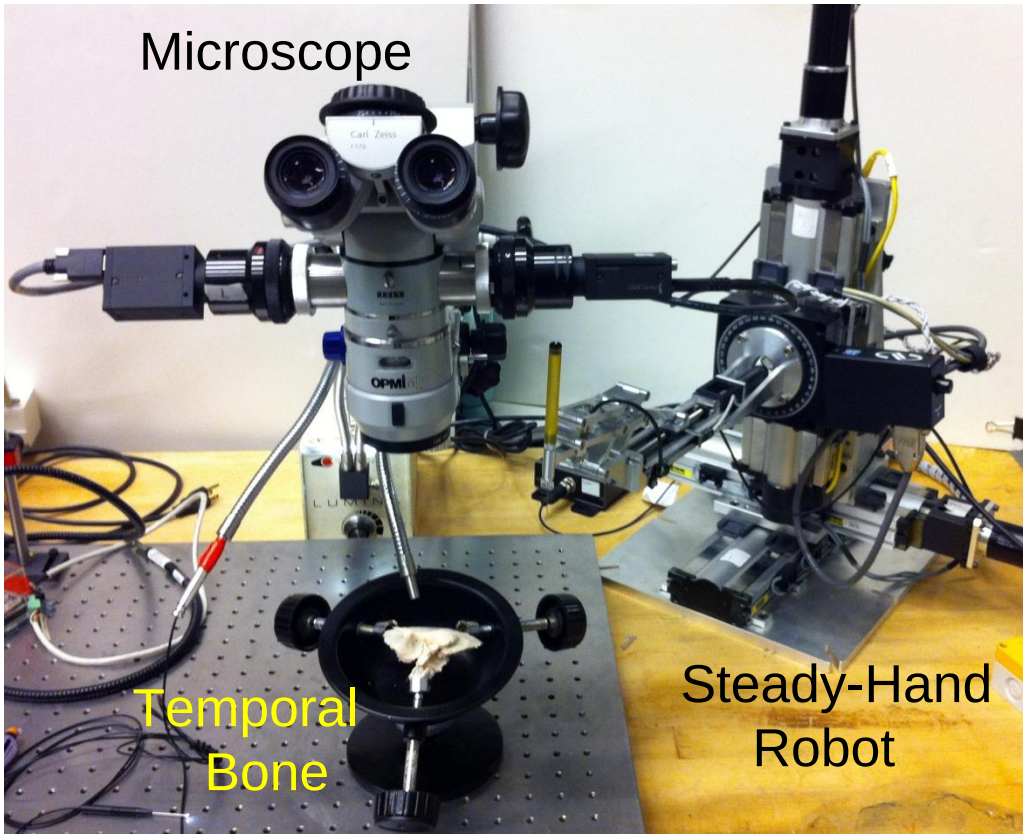
Background


4. Cochlea
3. Receiver & stimulator
2. Transmitting coil
1. Microphone & speech processor
© MAYO 1998, 2004
SIDE VIEW
FRONT VIEW

Our Approach





Imaging system: OCT → Micro-Borescope

Paper Selection

- H.W. Pau, E. Lankenau, T. Just, D. Behrend, and G. Hüttmann, "**Optical coherence tomography as an orientation guide in cochlear implant surgery?**," *Acta oto-laryngologica*, vol. 127, Sep. 2007, pp. 907-13.

- Klenzner, T., Ngan, C. C., Knapp, F. B., Knoop, H., Kromeier, J., Aschendorff, A., et al. (2009). **New strategies for high precision surgery of the temporal bone using a robotic approach for cochlear implantation**. *European Archives of Oto-Rhino-Laryngology*, 266(7), 955-960. Springer. doi: 10.1007/s00405-008-0825-3.

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Material & Methods

- Optical Coherence Tomography

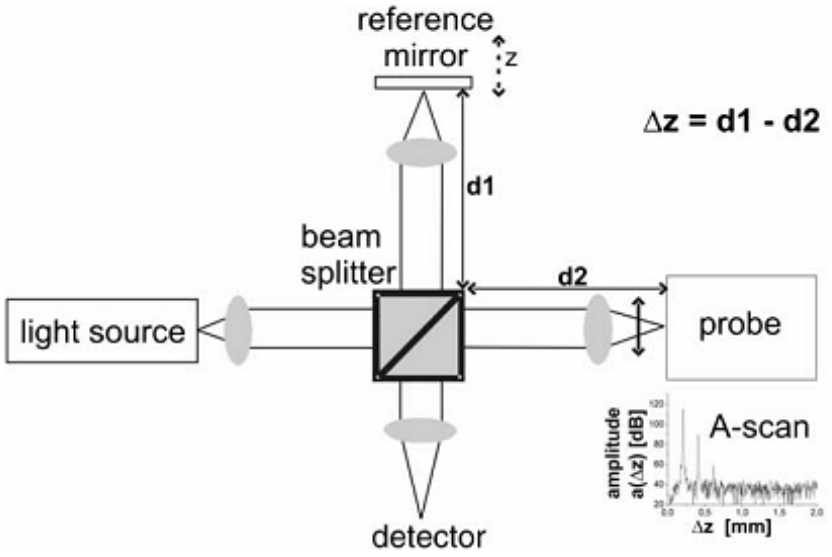
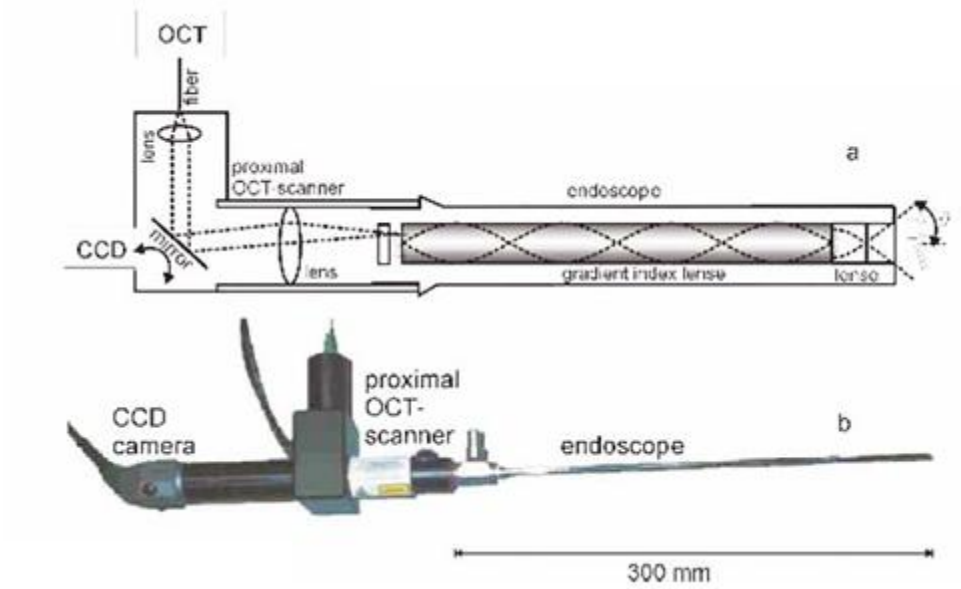


Figure 1. Schema of optical coherence tomography (OCT) (explanations are given in the text).

Pau *et al.* 2007

Different Applications of OCT



Pau *et al.* 2007

Material & Methods

- Preparation of temporal bones
  - Two temporal bone were grinded and cut for revealing the cochlear anatomy
  - Third temporal bone: preparations were performed as in real cochlear implant surgery

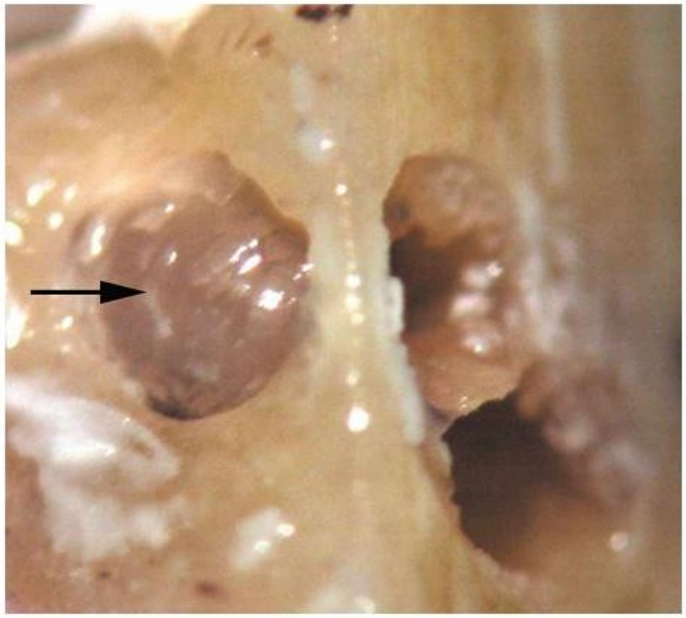


Figure 3. Temporal bone preparation (formalin-fixed temporal bone specimen, P1) with the cochlear endosteum exposed to the extent of approximately 1.5 × 1.5 mm (arrow). Slightly anterior to this 'fenestration' a cross-section through the temporal bone reveals the cochlear anatomy.

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Results: OCT Scan

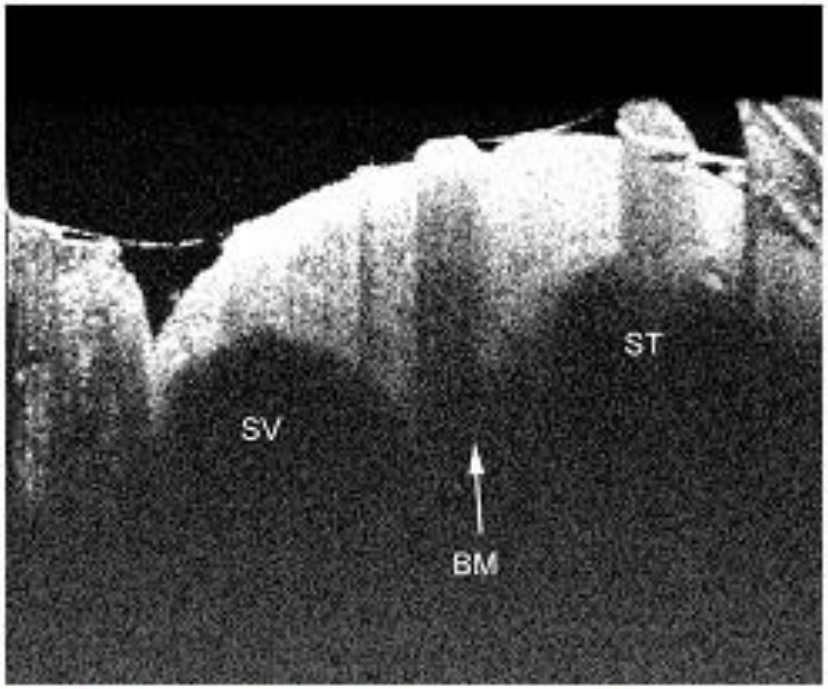


Figure 4. OCT scan representing a vertical cross-section through the lateral part of the cochlea in the formalin-fixed temporal bone (P1). The membranous sheath of the cochlea can be seen between two portions of bone bordering the 'fenestration' (left and right). The lateral borders of the scalae (SV = scala vestibuli, ST = scala tympani) can be detected with the 'ridge' of the basilar membrane (BM) in between (arrow).

Pau *et al.* 2007

- SV: scala vestibuli
- ST: scala tympani
- BM: basilar membrane

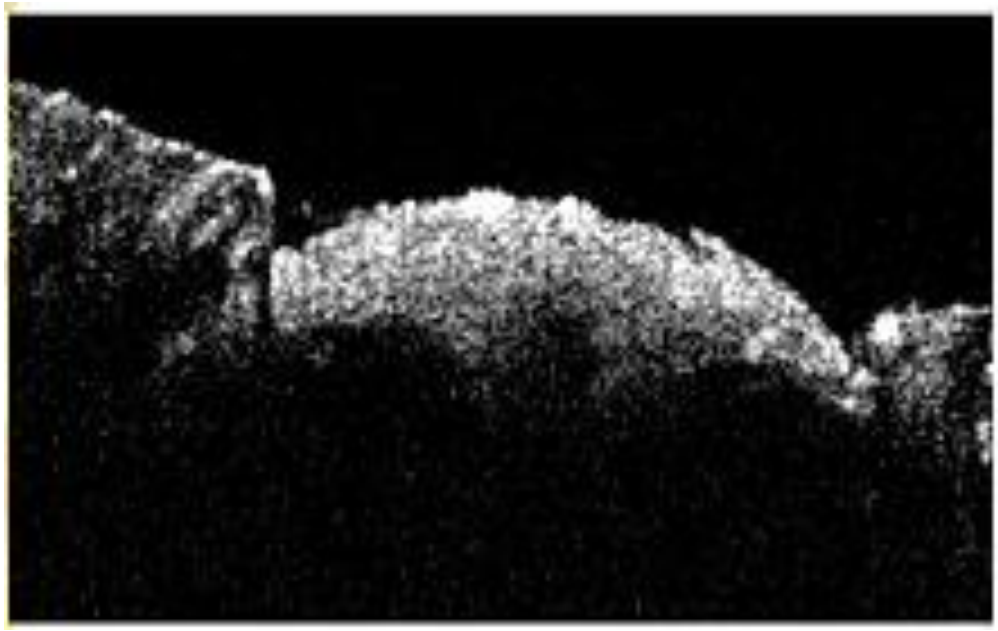
Results: OCT Scan

- Comparison of the OCT scan and the underlying anatomical structures

Pau *et al. 2*007

Results: OCT Scan

- The third fresh temporal bone



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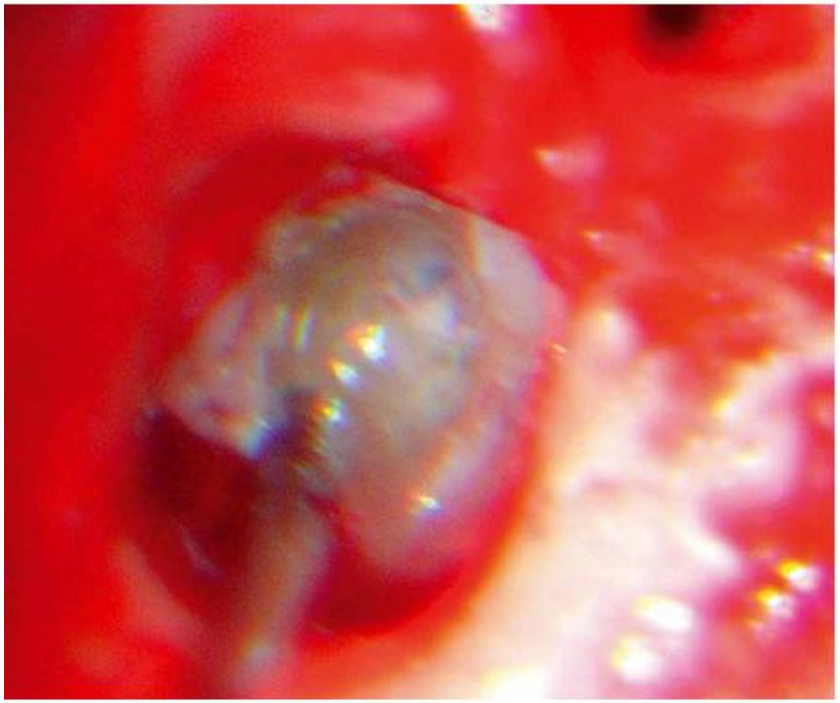
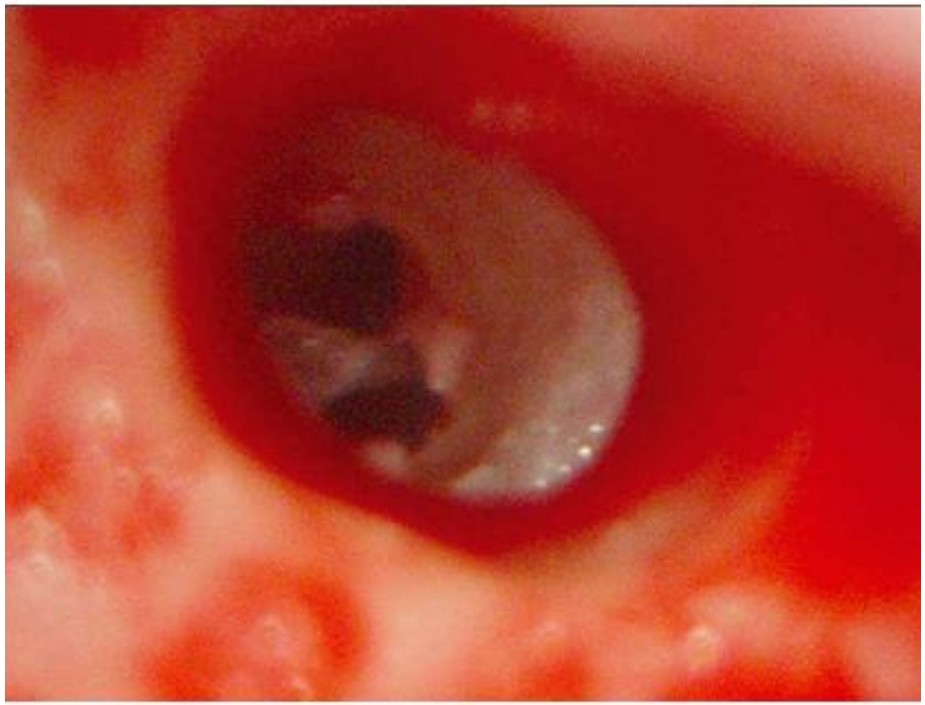
Discussion

- In the cochlear implant surgery …





Pau *et al.* 2007

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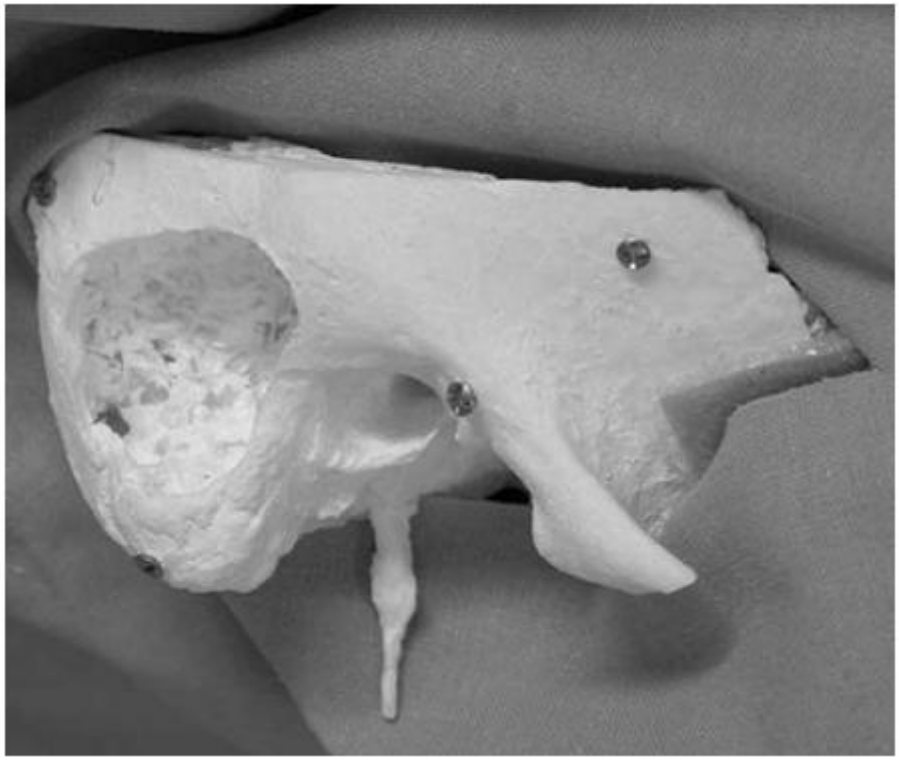
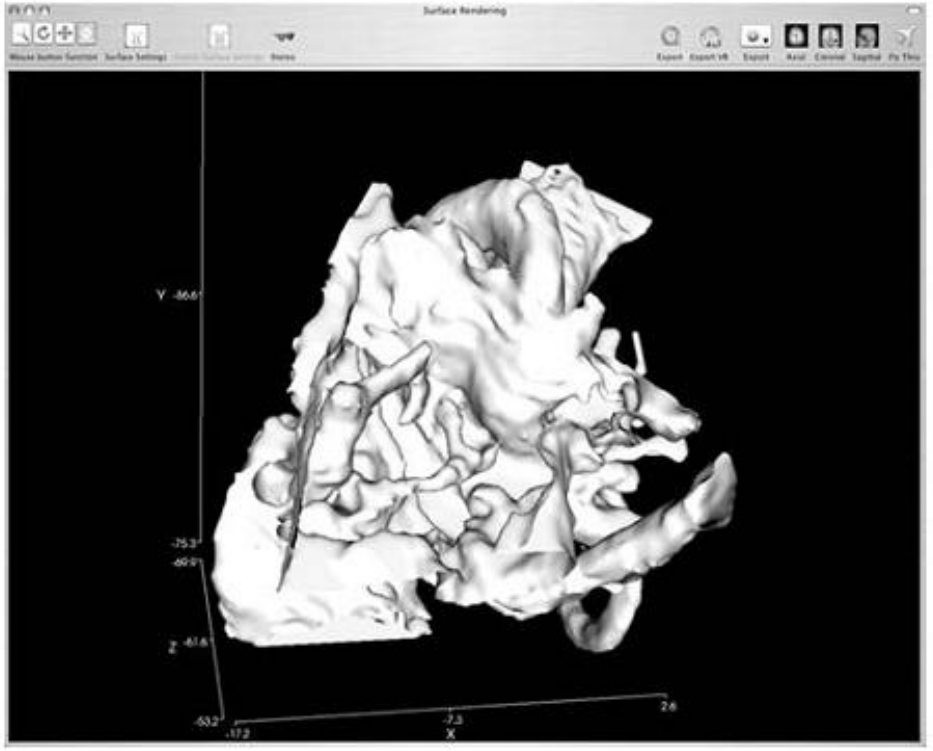
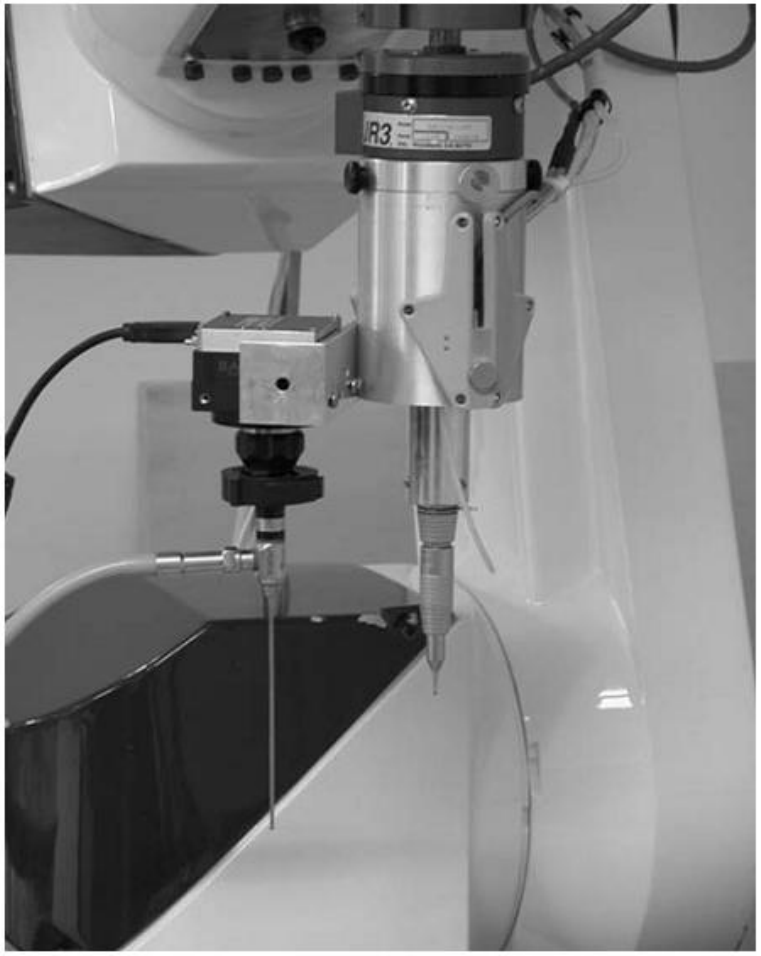
Material & Methods I





Klenzner *et al. 2*009

Material & Methods II



Klenzner *et al. 2009*

Results I

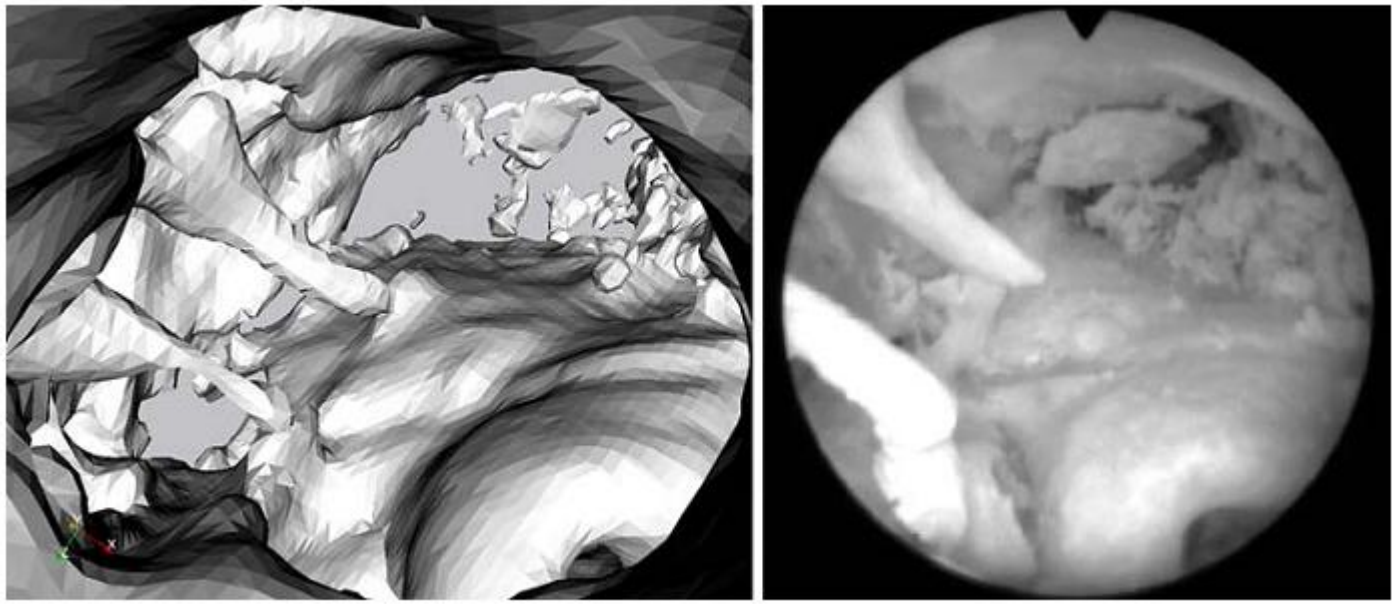
- Fiducial registration error: 0.3 mm
- Target registration error: 0.25 mm
- Desired target registration error <0.5 mm

	Fiducial registration error (FRE, in mm)	Target registration error (TRE, in mm)
1	0.42	0.30
2	0.19	0.13
3	0.51	0.37
4	0.24	0.17
Mean	**0.3**	**0.25**

Klenzner *et al. 2*009

Results II

- Endoscope advanced continously
- No collision or interference
- No major aberration detected between the endoscopic view and the model of virtual endoscopy of the 3D dataset



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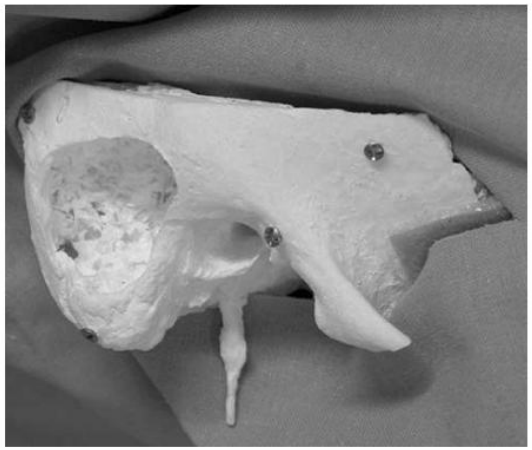
Future Work

- better CT imaging to reduce the registration error
- CO2-laser to replace the drill to avoid occurring forces
- better robot mechanism
- noninvasive registration method



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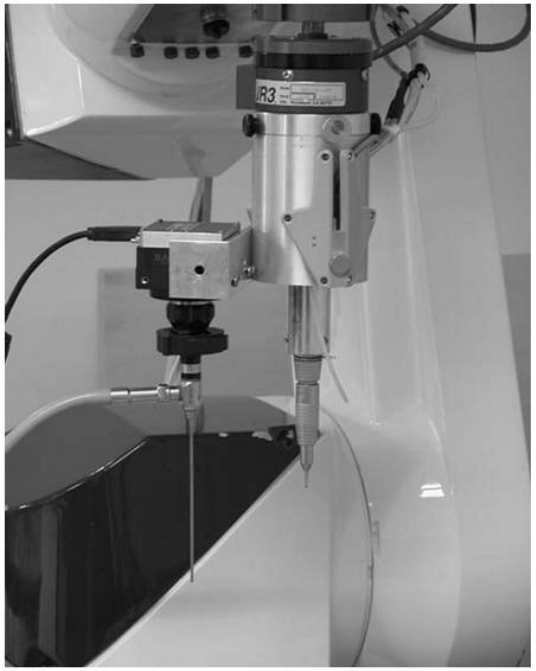
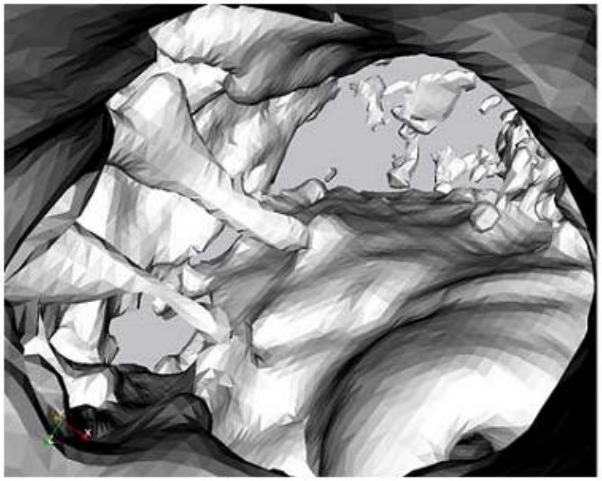
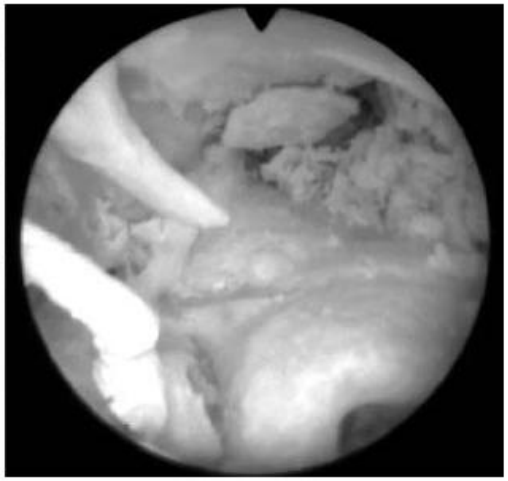
Pau *et al.* 2007







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Questions?