Postoperative characterization of robotically removed bone volume

Background

Robotic cochlear implantation involves the drilling of a minimal invasive tunnel through the mastoid by a surgical robot [1]. The accuracy of the RCI drilling procedure is determined by manually analyzing the bone volume removed during drilling. In the preoperative medical images, the geometric properties such as shape and pose of the tunnel are perfectly known. In the postoperative, however, the resulting cavity of the drilling is difficult to define because a) image quality is poor and b) missing bone and air cells cannot be distinguished.
The current approach to determine the required characteristics of the drilling (e.g. mean and max. error between planned and postoperative tunnel) is time-consuming and needs an experienced user. Furthermore, an extension of this manual approach from tunnel drilling to arbitrary volume milling is questionable. Therefore, an image analysis-based approach is proposed which uses pre- and postoperative CT data to characterize the removed bone volume.

Aim

Development and validation of a semi- or full-automatic system which allows a reproducible and accurate measurement of removed bone volumes in pre- and postoperative images.

Materials and Methods

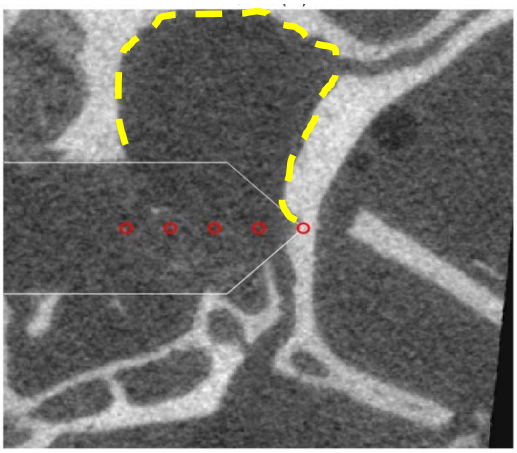
The candidate will develop a software tool to allow (semi- or fully- automatic) segmentation of the removed bone volumes in the surgery. The tool will be validated on a phantom developed by the candidate to determine the accuracy and precision of the removed bone volume. Subsequently, the tool will be integrated in existing framework to be tested on clinical data.

Work shares of the Thesis

- Image Processing/Analysis: 50 %
- Experimental study: 30 %
- Software development: 20 %

Skills and interests of thesis candidate

- Medical Image Processing
- Image-guided therapy
- Programming skills (Python, C++)



References

[1] S. Weber *et al.*, "Instrument flight to the inner ear," *Sci. Robot.*, vol. 2, no. 4, p. eaal4916, 2017.

Supervisors

Ankit Gupta, Jan Hermann, Juan Ansó

Examiners

Prof. Dr. Stefan Weber

Institute

Image Guided Therapy, ARTORG Center for Biomedical Engineering, University of Bern

Contact

Ankit Gupta, ankit.gupta@artorg.unibe.ch, Murtenstrasse 50 CH-3008 Bern, Tel. 031 632 7610