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## **Hochpräzisionschirurgie mit Robotern**

Keywords: surgical robot, skull base operation

### **Introduction:**

Previous research work on robotized osteotomies in CMF surgery results in an overall accuracy of up to 1 mm for the complete process chain. This was achieved by using the surgical robotic system Staebli RX90CR in 2003 [1]. Skull base operation requires to enhance the accuracy up to a value of 0.1 mm. Every step in the process chain has to be investigated to reach this goal. This was investigated exemplarily for the case of cochlear implantation.

### **Methods:**

The process chain starts with imaging of the situs. Based on a 3D-reconstruction the trajectories of the instruments will be planned [2]. As instrumentation guiding mechatronic system a highly precise hexapod robotic system with a repetitional position accuracy of below 0.01 mm was chosen. The registration process will be processed in two steps (1) markerbased with artificial landmarks (2) guided measuring of natural characteristic surfaces. The first step is carried out conventionally by using a commercial navigation system. For the image based guided measurement of the characteristic surfaces the 3D CT model is used as knowledge base for the interesting anatomical structures. This results in a very precise partial surface model registered to the origin of the hexapod robot [3]. Various measuring systems are under investigation. Our approach leads to a precise access to the situs with the intended range of up to 0.1 mm. In addition, conventional milling will be replaced by laser cutting.

### **Experimental set up:**

For our current experimental set up a high precision hexapod PI M 850 is been used. With this approach, the surface of the middle ear and additionally the underlying bony hidden structures of the inner ear could be made visible in an appropriate way for virtual surgical planning. Planning of trajectory and determining the point for cochleostomy was considerably facilitated with this virtual representation. First measurements showed an accuracy of <0.5 mm for fiducial registration of the marker screws and target registration errors at the borehole.

### **Conclusion and acknowledgement:**

The robot controlled and navigated guidance of instruments presents a solution for high precision surgery in cochlear. This research based on an enhanced 3D model of the tympanic cavity is the base for treatment concepts in the skull base.

### **References:**

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