

# **Die Visualisierung der zu erwartenden Zielpunktgenauigkeit für die kranielle Neuronavigation**

## **Visualization of target error prediction for cranial neuronavigation**

Sven Mularski<sup>1</sup>, Süß O<sup>2</sup>, Schönherr S<sup>3</sup>, Kühn B<sup>2</sup>, Brock M<sup>2</sup>

<sup>1</sup>Neurochirurgische Klinik  
Charité - Universitätsmedizin Berlin  
Campus Benjamin Franklin (CBF)

<sup>2</sup>Neurochirurgische Klinik Charité - Universitätsmedizin Berlin Campus Benjamin Franklin  
(CBF)

<sup>3</sup>Institut für Informatik - Freie Universität Berlin

### **Introduction**

After the procedure of fiducial registration, most navigation systems provide the user with information on the Fiducial Registration Error (FRE), thereby implying a value for the system's accuracy. Nevertheless, studies using mathematical models for accuracy calculations have shown that not the FRE but only the Target Registration Error (TRE) gives reliable information on the intraoperative accuracy of a navigation system. TRE itself depends e.g. on the number of fiducials or landmarks used, the configuration of the fiducials as well as on influences of the point-to-point matching. Unfortunately, TRE can not be measured directly during the registration process. Therefore, a mathematical model has been developed to give an estimation of the registration accuracy for a specific target point or area of interest.

### **Material & Methods**

The ACCISS II TM neuronavigation system (Schaerer Mayfield Technologies GmbH, Waltersdorf, Germany) was upgraded with a software tool, which allows a visualization of the target error prediction during data preparation and the following registration process. Therefore, three ellipsoid areas are displayed in the slice views of the navigation screen (Figure 1). These areas visualize the predicted standard deviation of the TRE at intervals of one millimeter, in which the central ellipsoid area represents the region with a TRE standard deviation of 1mm and below. This enables the surgeon to control if the region of

interest, namely the lesion to be resected, is located in the area with the best TRE. If not, additional markers, such as anatomical landmarks were defined in order to improve the predicted TRE in the area of interest.

## Results

Laboratory tests with different skull models (3B Scientific's Systemscanal A280/281) and different fiducial configurations were performed in order to evaluate the clinical useability of this new software tool. The measurements showed that the system predicted TRE gives reliable information about the accuracy of the navigation in steps of 1mm. It turned out that e.g. targets predicted to be outside the 3mm standard deviation area could be found at a distance of 3mm and over to their corresponding points on the preoperative images after registration, whereas points displayed within the 1mm standard deviation area were to be found trustworthy at a distance of 1mm and below. Furthermore, it could be demonstrated that the area of the best TRE could be improved e.g. by changing the fiducial configuration or by adding anatomical landmarks already during data preparation.

## Discussion

The visualization of the TRE is a useful tool to provide feedback to the surgeon about placement and configuration of fiducials during data preparation as well as during registration. Particularly by choosing different fiducial configurations or by adding additional anatomical landmarks, an improvement in placing the area of interest close to or within the area of the best TRE can be achieved. This leads to increased accuracy during surgery by providing and visualizing a reliable error estimation already before the start of surgery.

