

Section: Intraoperative Bildgebung

ID: 6

Abstract-Title:

A PHANTOM FOR A NEW EASY-TO-USE BENCHMARK TEST FOR POINTER NAVIGATION
EIN PHANTOM FÜR EINEN NEUEN EINFACHEN VERGLEICHSTEST FÜR DIE POINTERNAVIGATION

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Abstract-Text:

Purpose

In this article we describe a simple benchmark test that we use to compare the system accuracy of pointer based navigation systems with a novel phantom skull. Several different methods of patient registration are used in current pointer-based navigation systems for maxillofacial surgery. Especially the non-invasive methods like anatomical landmarks and three-dimensional surface registration can cause high accuracy error depending on factors like the number and location of the acquired registration points. In the case of patients with retained foreign objects, pointer-based navigation systems can be used for supporting the removal of these objects with minimal invasive access. This clinical indication requires a high overall accuracy below 1mm to identify the small objects. To simulate the clinical intervention pre-operatively and to determine the overall accuracy of the pointer-based navigation, we developed a test phantom that can be easily used by a surgeon. Method Thirty metallic cylindrical objects with diameters of 1, 2 and 3 mm – ten of each size – were integrated in the frontal and parietal bone of a phantom skull, see figure 1. All thirty objects were connected via thin wires to a piezo beeper powered by an external 5V power supply. The frontal and parietal bone is covered with opaque wax plates, hiding the integrated objects. A cable with a clamp was used to connect the internal circuit with a metallic navigated pointer. Phantom image data was acquired with a CT-Scanner (GE LightSpeed, 0.6 mm, voxel 0.5 x 0.5 mm). Benchmarking is performed by the following steps. 1. Phantom image data is loaded into a commercially available pointer-based navigation system. 2. The clamp is attached to a pointer instrument and a patient localizer is fixed to the phantom skull. 3. Patient registration method is selected and performed. 4. The navigation system displays the pointer tip in the three orthogonal slices and in the generated 3D model. 5. Optionally, by selecting a higher threshold value for skin generation in the 3D model, the wax skin is removed and the foreign objects can easily be localized with the displayed pointer tip in the image data, see figure 3. 6. If the system works accurate enough the pointer tip touches the content under the wax-skin and the beeper is activated. By touching the objects with different diameters while counting the acoustic signal, the overall accuracy of the system can simply be assessed. For verifying the usability of the phantom we performed the benchmark test with the navigation system NaviBase ENT (RoboDent GmbH). Results

The phantom skull was evaluated by two different users (engineer and surgeon). They performed two tests each using anatomical landmarks and fiducial based registration, respectively. The results are listed in the table 1 below. For the fiducial based registration

a higher hit rate was achieved, as expected. The phantom skull could easily and intuitively be used with a commercial navigation system. Conclusion

A phantom skull for a simple benchmark and evaluation of the overall system accuracy for pointer based navigation systems was presented. The integration of metallic objects in a skull phantom and a simple acoustic electronic circuit allows a pre-operative simulation of a navigated clinical intervention in maxillofacial surgery. The surgeon can evaluate the different registration methods offered by existing navigation systems and select the optimum system setup for the special clinical intervention. The procedure leads to immediate results that are easy to interpret in means of accuracy.

Bild 1/JPG

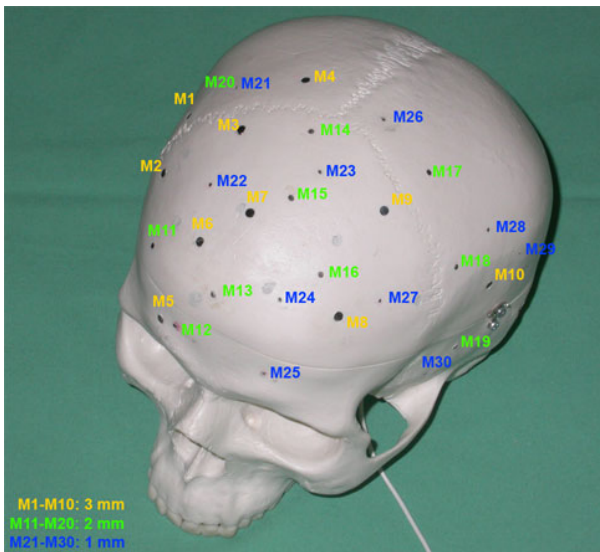


Bild 2/JPG

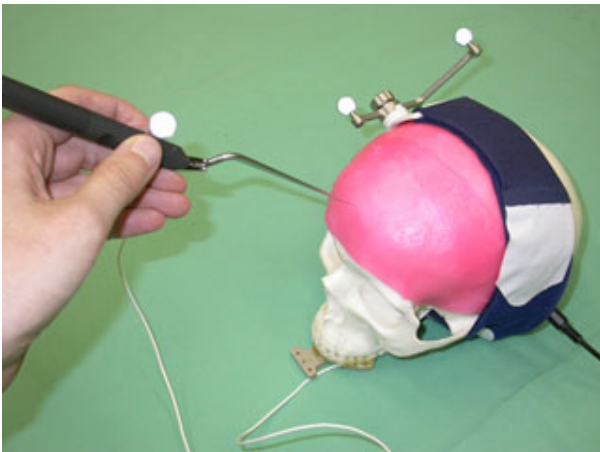


Bild 3/JPG

