Section: **Visualisierung**

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Abstract-Title:
INTRAOPERATIVE THREE-DIMENSIONAL VISUALIZATION FOR IMPROVEDMICROVASCULAR DECOMPRESSIONINTRAOPERATIVE DREIDIMENSIONALE VISUALISIERUNG ZUR VERBESSERUNGMIKROVASKULÄRER DEKOMPRESSION

Authors:
P. Hastreiter[1], L. Tanrikulu[1], R. Naraghi[1]
[1] Neurochirurgische Klinik, Neurozentrum

Abstract-Text:
Purpose
The anatomical relationship between nerves and vessels at the surfaceof the brainstem is very complex. Insight into the posterior fossa was only gained by precise anatomical preparation during invasive procedures. High resolution magnetic resonance imaging (MRI) allows for the analysis of the target structures. However, 2D slice representations are regarded as insufficient for the evaluation of this complex anatomy. Improved representations contribute tremendously to the understanding of neurovascular compression syndromes which are associated with diseases such as trigeminal neuralgia and even arterial hypertension. Overcoming existing limitations we have introduced robust methods of image processing and 3D visualization. So far, a methodical application and evaluation of 3D visualization into micro-neurosurgical operations of neurovascular compression syndromes has not been presented.

Methods
Intraoperative 3D-visualization was introduced into microvascular decompression of a prospective and consecutive series of 50 patients with trigeminal neuralgia, hemifacial spasm and glossopharyngeal neuralgia. Prior to the operation, strongly T2-weighted MR-CISS (Constructive Interference in the Steady State) and MR angiography data were obtained. Image processing consisted of coarse explicit segmentation of the CSF area, the brainstem and the cranial nerves. In order to obtain precise 3D representations of the tiny structures within the posterior fossa implicit segmentation with transfer functions based on direct volume rendering was applied. In order to overcome large CSF artifacts, manual corrections were made based on the anatomical knowledge of an expert. Additionally, the available MR data were fused allowing for fully optimized representations. During the operation, the interactive 3D visualization was at the surgeon\'s direct disposal under sterile conditions. The computer system was mounted on a mobile platform. Its value in the ultimate proximity to

the operation field was analyzed using plasma sterilized computer components (infrared mouse and infrared keyboard). The topography of the relevant neurovascular structures was inspected and compared with the intraoperative findings.

Results

In all cases microvascular decompression was successfully carried out and the nerve-vessel relations were intraoperatively explored with interactive 3D visualization. Several positions of the mobile visualization unit were examined in the operating theater. The position between the surgeon and the assistant in correspondence to craniectomy and the microscope was found out to be ideal. Thereby, surgical convenience was fulfilled and other participants in the operating theater were not disturbed. There were no episodes of malfunctioning hard- and software components during surgery. Using intraoperative 3D visualization based on optimized preoperative image processing, all relevant structures were conveniently delineated and unnecessary surgical manipulations were reduced. Based on the comprehensive spatial representations with detailed anatomical information, the surgeon was considerably assisted. Plasma sterilization of the wireless components took about 75 minutes and the average time for surgery was not elevated by intraoperative 3D visualization.

Conclusion

An approach for intraoperative 3D visualization during microvascular decompression was presented and analyzed. This is the first introduction of interactive 3D-visualization into the process of routine surgery. Using a mobile visualization unit and plasma sterilization of surgical components, detailed 3D representations of the relevant nerve-vessel relations were introduced into the ultimate proximity of surgery. The intraoperative application of interactive 3D visualization provided flexibility, superior safety and improved surgical results. Minor adjustments of the presented strategy might also make the approach applicable to other fields of micro-neurosurgery such as aneurysm clipping.