Cost-efficient Craniotomy Simulation and Planning of EC-IC Bypass Surgery with a Newly Developed Software Tool and its Validation through Transdural ICG-Videoangiography.

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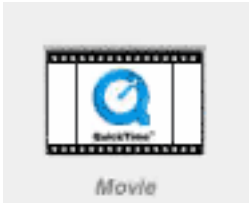
Introduction

The focus of the presented clinical research project is dedicated to offer state-of-the-art virtual planning tools under simultaneous maximization of cost-efficiency inside the OR. This abstract summarizes our experiences using a self-developed bone removal plug-in software to preoperatively plan minimally-invasive approaches in EC-IC bypass surgery and its intraoperative validation through transdural ICG-angiography.

Methods

A virtual bone removal tool was developed in cooperation with TU Wien, Institute of Computer Graphics, as a plug-in for the OsiriX software (Pixmeo, Geneva, Switzerland). By simple point-and-click interaction, the exact emplacement of the intended approach is specified and a virtual craniotomy is created by removing the marked region from the skull. The location is converted to coordinates in a patient-specific coordinate system and subsequently transferred to the skin using flexible rulers. Prior to dural opening, the identification of the preoperatively planned recipient artery was performed by indocyanine green video-angiography (ICG-VA) and postoperatively validated by comparing pre- and postoperative



Results

We present our series of fourteen consecutive patients undergoing revascularization surgery (direct and indirect revascularization). Preoperative identification and segmentation of donor/ recipient vessels and exact placement of craniotomy with our presented tool took the principal investigator a mean of 127sec (ranging from 55 to 238 sec). The intraoperative transfer and marking of the calculated craniotomy coordinates on the patient's skin lasted a mean of 50sec (ranging from 20 to 120sec). The cortical recipient artery (in the 12 direct revascularization cases) proved in all cases to correspond to the preoperatively defined target, as the validation through intraoperative transdural ICG-VA and postoperative CTA scans demonstrated.

Proof-of-concept Demonstration

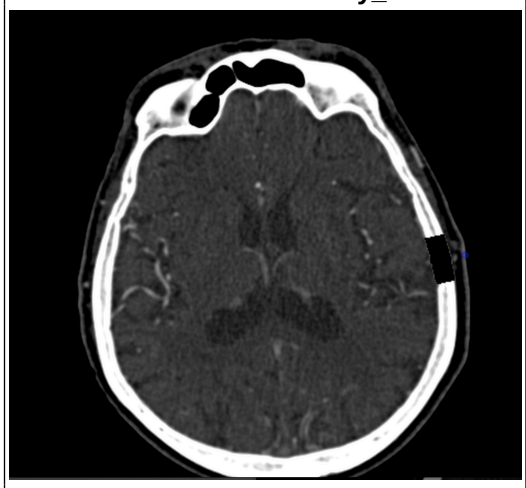
Conclusions

We present our first experiences planning minimally-invasive approaches in EC-IC bypass surgery with a newly developed bone removal software tool. This validated technique should be recognized as a cost- and time-efficient alternative to conventional neuronavigational systems, with the main benefit of planning neurosurgical approaches with simple point-and-click user interactions on standard consumer hardware.

Learning Objectives

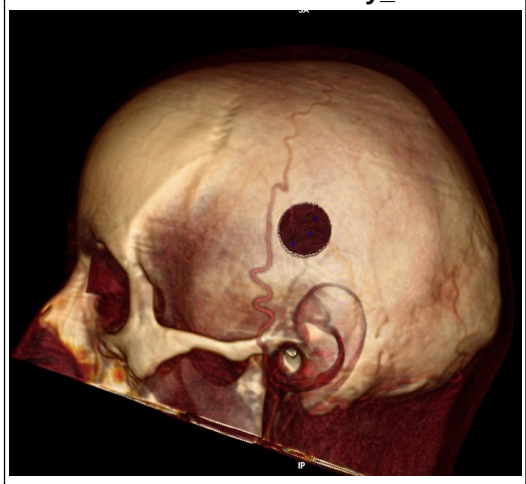
By the conclusion of this session, participants should be able to assess the potential and usability of the presented **self-developped proof-of-concept software**, identify specific pathologies and indications (revascularization procedures, among others) that would benefit from extensive planning modalities on consumer hardware.

Simulated Craniotomy_CTA



Original preoperative CTA scan with removed bone over angular region of distal MCA territory.

Simulated craniotomy_3D



Virtual Model of Simulated Minimally-Invasive Craniotomy