Use of bone anchoring device in electromagnetic computer-assisted navigation in lateral skull base surgery

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Abstract

Conclusion: The use of the bone anchoring device associated with a fiducial marker, both fixed close to the operating field, improves the reproducibility and effectiveness of the computer-assisted navigation in lateral skull base surgery. Objectives: Computer-assisted navigation in lateral skull base surgery using the electromagnetic system Digipointeur® needs an external fiducial marker (titanium screw) close to the operating field to increase position accuracy (PA) to about 1 mm. Displacement of the emitter placed in the mouth (Buccostat®) induces a drift of the system, leading to at least 20% of unsuccessful procedures. The aim of this study was to evaluate the PA, stability, and reproducibility of computer-assisted navigation in lateral skull base surgery using a bone anchoring device to provide a fixed registration system near the operating field. Methods: Forty patients undergoing a lateral skull base procedure with the Digipointeur® system performed with both the titanium screw and bone anchoring device were included in this prospective study. They were divided in two groups. In the first group (n = 9), the PA was measured before and after screw registration for patient-to-image registration; the emitter was placed in the mouth (Buccostat®). In the second group (n = 31), all lateral skull base procedures were included and the PA was evaluated visually by the surgeon on different landmarks of the approaches as well as the stability of the system. Results: In the first group, the PA was 7.08 ± 0.59 mm and 0.77 ± 0.17 mm (mean ± SEM, p < 0.0001) before and after screw registration, respectively. In the second group, the PA was considered as accurate by the surgeon in all cases and no drift of the system was observed. Computer-assisted surgery was never abandoned due to increased stability of the bone-anchored emitter.

Keywords: Computer-assisted surgery, middle cranial fossa, facial nerve, translabyrinthine, vestibular schwannoma, navigation

Introduction

Computer-assisted navigation (CAN) in ENT surgery has been used for many years in endoscopic sinus surgery [1–3]. It is a useful tool for the surgeon in difficult anatomic areas with identification and location of a dangerous zone or when the normal anatomy has been altered by pathology. There are two main navigation systems for lateral skull base surgery: opto-electronic and electromagnetic systems.

The opto-electronic systems are based on the use of two or three high-definition CCD cameras located far from the operating field. These cameras analyze the position of two or three light-emitting diodes mounted on the surgical instrument. These systems were designed for the neurosurgical field and one disadvantage of them is that they required a free field of visualization between infrared cameras and the light-emitting diodes, so no microscope, person or instrument should be interposed between the emitter and receiver.

The electromagnetic system Digipointeur® (Collin, Bagneux, France) is based on mid-facial skin contouring for patient-to-image registration; the emitter...