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Editorial

Addicted to Technology? Neurosurgeons, Too!

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Technological equipment is not only an integral part of modern clinical and obviously laboratory practice, but also of the surgical and especially the neurosurgical routine. The operating rooms where the basic characters were the scrub nurse, the surgeon and his suction and bipolar cautery looks like already as history! One of the neurosurgeons' modern favorite devices is a navigation system, which is a system that guides the surgeon by tracking in real time some specific instruments and showing on a screen the position of those instruments in relation to the head's structures on some type of imaging method (e.g. head MRI or CT scan). In essence, navigation (or neuronavigation, or image-guidance) matches the radiologic data's space with the physical space of the operative field.

The neurosurgical operative field is usually either narrow (i.e. a craniotomy) or even absent (e.g. a burr hole for brain biopsy), in order to minimize the damage. Therefore, the neurosurgeon cannot often locate reliably or even at all, all the relevant anatomical elements, functional areas and targets. In addition, each patient's anatomy differs to a degree significant for the performance of a safe and effective procedure. In other words, the neurosurgeon needs to know the precise location of various anatomical structures (pre- and intra-operatively), the neurosurgical instruments' position intraoperatively in relation to those structures, and how the target can be reached safely, by avoiding critical anatomical elements or functional areas and causing the least possible damage of normal tissue. Taking also into consideration that the neural tissue is really vulnerable and its damage often irreversible, which may lead to various degrees of disability; the neurosurgical community traditionally followed passionately and used the technological advances of each era to overcome the inherent difficulties of this specialty [1]. In the previous decades, the abovementioned problems were managed partially based only on the neurosurgeon's thorough knowledge of anatomy, e.g. during tumors' removal, and on various demanding methods depending on the operation, e.g. in the case of brain biopsies using cumbersome stereotactic apparatuses.

The exponential growth of technology and computer processing capabilities in connection with the philosophy of stereotactic neurosurgery and the progress specifically in medical imaging were the basis for the development of navigation systems; which were designed in order to perform more effective, accurate and convenient, safer and less invasive neurosurgical operations [2]. Surgical navigation was firstly invented in 1986 by a neurosurgeon: David Roberts, marking only the beginning of an amazing ongoing progress of the surgical navigation [3]. Modern intraoperative navigation systems provide several significant and advantageous functions, e.g. multiplanar image reconstruction and three-dimensional (3D) planning (preoperative and intraoperative), real-time intraoperative surgical instrument guidance, and precise localization of intracranial targets [4,5]. Moreover, they include many useful tools (e.g. measurement tools) and they can implement scans from many imaging methods (e.g. CT, MRI, functional MRI (fMRI), Tractography, and Positron Emmision Tomography).

Although the history of navigation is closely connected with the history of Neurosurgery, it was also afterwards expanded to other surgical disciplines, e.g. Spine surgery, Orthopedics, Craniomaxillofacial, Otorhinolaryngology (ENT) or even abdominal operations. Navigation systems can be used for numerous neurosurgical applications being an invaluable investment for any modern neurosurgical department (see Table). It seems that the only neurosurgeons that have not been addicted to navigation systems are those that do not have them available in their hospitals or few exceptions, like the worldwide famous neurosurgeon professor Hugues Duffau

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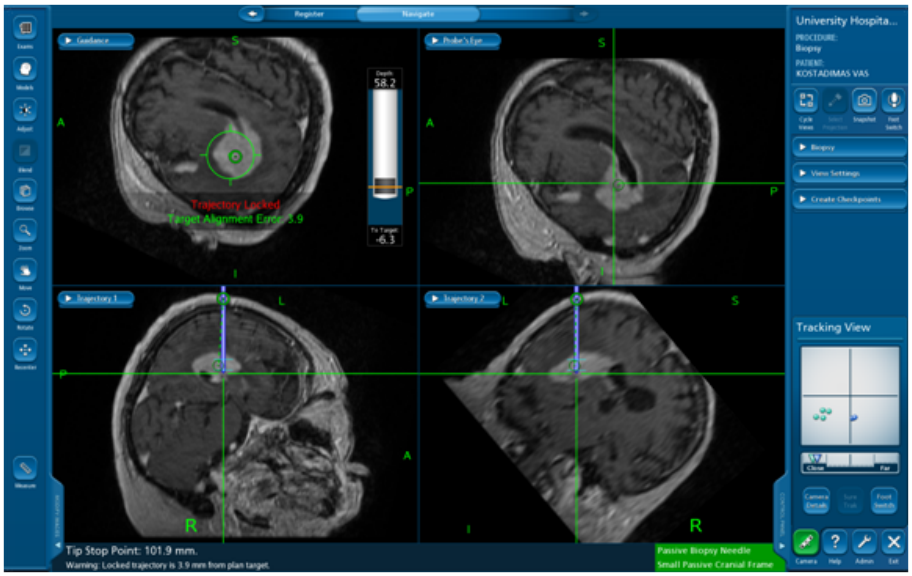

Figure 1: Image from the navigation system: StealthStation® S7™ (Medtronic Inc., Minneapolis, MN, USA), during the performance of a brain biopsy. The trajectory of the biopsy needle and the depth of its port are shown in real time and in three different probe's eye views (axial, sagittal and coronal probe's eye views). (Department of Neurosurgery, University Hospital of Patras, Faculty of Medicine, University of Patras, Greece)

Applications of navigation systems in Neurosurgery
Accurate execution of craniotomies and in cases of brain tumors removal (recently in posterior fossa lesions, too)
Brain biopsy **In case of cystic lesions: Drainage** **In case of suspected infection: Pathogen identification and antibiogram**
Placement of intraventricular catheters (e.g. placement of cerebrospinal fluid (CSF) shunt systems in difficult cases or Ommaya catheter)
Aspiration of hematomas
Deep brain stimulation operations
Percutaneous procedures in Trigeminal Neuralgia (penetration of the foramen ovale)
Spinal surgery: minimally invasive percutaneous operations – instrumentation

[1,4,8-11]

a true surgical neuroanatomist who prefers to rely only on his knowledge and eyes with astonishing published work unraveling the mysteries of the brain! [6,7].

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