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Letter to the Editor
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A Glimpse on the Future of Neurosurgery

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Letter to the Editor

Neurological surgery was recognized as a specialty in the early 20th century. Brain surgeries are delicate, especially when it comes to removing cerebral tumors or spine problems correction. In the last two decades, neurosurgery has evolved with regard to the technology used in the procedures. However, the use of technology involves techniques and protocols, so that it is used correctly and allows the best results. Today the reality aim is removing the tumor, reducing tissue damage, avoids sequel and morbidities, in addition to improving postoperative conditions and the quality of life of patients.

The opening of the skull is variable in size, shape and region of interest. It is up to the neurosurgeon to choose these important details, according to the patient's clinical condition. Within the best technique, which involves expertise, the neurosurgeon must seek, among other concerns, to determine the best location for the opening. The objective is the maximum preservation of the anatomy with the least aggression to the organism of the patient. This is in fact the minimally invasive meaning.

A complete understanding of the relationship of the various anatomical structures involved in a minimally invasive surgery is essential for this type of procedure and for the determination of the stages of performing this surgery (both preparatory and intraoperative stages), with the objective of success and resolution of the problem of using a technique that is less invasive.

Among the technologies that contribute to this change, cine-MRI (cine-Magnetic Resonance Image), endoscopes and neuronavigation, and even, new visual technologies as exoscopes are the most commonly ways used at this time. So, they are those that directly concern to this edition. But also even more, the continuously evolution with the neural integrated intelligent implants, especially for some brain disease and spinal cord surgery. Artificial Intelligence is a new *intelligence armamentarium* that can help us in the diagnoses and surgical procedures.

The brain has cavities filled with cerebrospinal fluid that are called cerebral ventricles. Through a small perforation in the skull (trepanation), an endoscope can be introduced, in a safe and minimally invasive manner, until it reaches the cerebral ventricles, for example. Images are transmitted by an optical system to a monitor installed in the operating room, through which the neurosurgeon guides him to perform the surgery. There are several types of endoscopes. The choice of the type of endoscope to be used in each case is part of the prior planning of the procedure. This choice is directly linked to the location of the injury to be achieved and also to the type of injury.

Neuronavigation is the set of computer-assisted technologies used by neurosurgeons to guide or "navigate" within the confines of the skull, or vertebral column during surgery or for cerebral surgery, among others.

Ate now, the most common use of Artificial Intelligence techniques, is Machine Learning. In general, applied to medicine, it is use for image analysis. For Example, the Artificial Intelligence diagnosis tools rich a very good confidence degree in some different types of cancer. This algorithmic are training using MRI images. Neuroscience has been in dialogue with AI in recent years. Functional MRI (f-MRI) has inspired the construction of Neural Network models for Machine Learning.

Regarding to implants, examples are already in place for hearing (still very invasive), visual loss and stimulating for Parkinson's were developed at the last century. But evolutionarily new more audacious applications, as implants for other damaged brain functions, or even to enlarge its capabilities, are being promised for this century.

Minimally invasive neurosurgery brings a portal for new devices of robotic surgery and nanotechnologies. With this minimization thinking we provide less damage and concise effectiveness. Advances in robotics, promise to us for the near future, in addition to robot arms, a full robot that

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can be operated in person or remotely by a neurosurgeon. This mode of thinking also brings to the scenery the nanorobots technology in the earliest of this century. As an example, the *nanobots* could be the way to transport the new genetic personalized drugs to the pathologic cell, and even in an endovascular procedure.

At last, concerning the new technologies, the Robotic and Nanotechnology are still a promise to provide an evolution in regenerative medicine and the sensitive detection of cancer-related molecules, enabling scientists to detect molecular changes even when they occur only in a small percentage of cells. Nanotechnology also has the potential to generate entirely novel and highly effective therapeutic agents. So, this technology and some regenerative medicine products shown a great potential, but still limited at market success.