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EDITORIAL - NEUROSURGICAL TECHNIQUES

Have 3D endoscopes succeeded in neurosurgery?

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In recent years endoscopy has represented a terrific advancement in daily neurosurgical practice all over the world, thanks to the ability of the endoscope itself to allow an intrusive vision of the relevant anatomy with a wide and close-up view of the surgical target structures. This has proved to be very useful and widely used, mainly in the treatment of different pathologic conditions of the cerebral ventricles [4] and in transsphenoidal surgery for pituitary adenomas, and also for nonadenomatous lesions of the sellar and perisellar areas [3, 6, 12, 17, 11, 8].

Nevertheless, current endoscopes provide a bidimensional view, and the image as seen on the monitor is the result of a computer elaboration process. Spatial and depth information loss, however, could be overcome on one hand with the ongoing experience of the surgeon, and on the other by the capability of the human brain to elaborate secondary spatial depth cues, i.e. shadows, lights, and parallax movements [2, 13–15].

It seems that introduction and evolution of 3D technology in endoscopic surgery [1, 7, 9, 10, 18, 19] has been identified as a viable solution to overcome some limits of 2D vision, despite the tremendous improvements brought in by the HD system [16].

We cannot deny or minimize the terrific work made by industries in improving 3D technology that deserve care and time to be realized. In such a way, 3D endoscopes represent an important step forward as compared to previous generations, even if the 3D images still come from the acquisition of a single sensor (now offering full HD resolution). Anyway, currently there are still several limitations that would limit 3D endoscopy taking over the 2D endoscopes. In fact, 3D technology has been initially introduced in laparoscopic surgery, where it is possible to use cameras, lenses, and instruments of bigger sizes, thus allowing production of better images when compared with neurosurgery. Despite such potential advantages, 3D laparoscopy still remains secondary, suggesting that it is not a matter of size but rather of the technology of the 3D image production and perception. So, even though there are recent contributions that shed light on the benefits of 3D endoscopic technology, a massive shift to the use of 3D has not been observed; rather, it has been advocated as an adjunct to the conventional 2D endoscopic technology. Furthermore, this happened only in selected centers, either because of the higher costs of the 3D technology or the difficulties in adapting to the tridimensional vision using goggles.

This condition mostly resembles what is happening in the cinematographic and videogame industries. Many of us have been observing early 3D movies, mainly cartoons, and were definitely fascinated by them. Though, backing upon innovation success, production industries are making conspicuous financial and technical efforts to create 3D movies, and also to re-master classic blockbusters with this technology. However, it seems that not every movie could take advantage of the 3D technology rendering, and above all, too many people still complain of difficulties in adapting to this kind of vision, such as headache, nausea, dizziness, and myodesopsis. So recently, the same industries made up their mind and established a new trend with the creation of two versions of the same product, i.e., a 3D HD one and a conventional HD one. The videogames also adopted the same strategy: for instance, the Nintendo 3DS®—latest generation of portable consoles—has been the first to realize a 3D view effect without goggles, but it allows the player to immediately and effectively shift between

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2D and 3D. The choice of vision is highly demanded in players' adaptability and game features, allowing a double option.

A similar strategy has been adopted to develop some 3D endoscopes: a conventional endoscope can be connected to an HD camera, but bigger than its previous version, thus providing the opportunity to switch easily between 2D and 3D view.

Besides 3D—still burdened by the need of goggles—we should mention the development of Ultra-HD technology systems (UHD), which can offer images with resolution up to 7680 pixels wide by 4320 pixels tall (33.2 megapixels), which contain sixteen times more pixels than current Full HD.

In the last decade technological progress has led to tremendous improvements in terms of image quality, but a similar boost in terms of miniaturization of camera-endoscope coupled devices did not happen, at least in neurosurgery. We hope that in the next steps of this evolutionary process, reduction of sizes could be accomplished, and the endoscope-camera coupled device could be easily maneuvered by the surgeon as any other microsurgical instrument (2D or 3D).

It cannot be overstated that ultimately 3D endoscopy will gain more room in surgery and will finally succeed, and we do not see any reason to stay or to resist this progress. In order to achieve such attitudes as we did in the controversy between endoscopic endonasal versus transcranial surgery [5], we advise the same attitude in defining the role of technology in the present and future assessment of endoscopes in neuroendoscopy. No doubt 3D will contribute to significant improvements that are and will also be coming from 3D not associated with a single sensor, as well as with ultra HD vision and miniaturization.

Conflicts of interest None.

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