# Innovation in Neurosurgery: Results from an International Survey

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CNS 2017 ANNUAL MEETING
BOSTON, MASSACHUSETTS
OCTOBER 7–11, 2017

## Learning Objectives

1) To appreciate the lack of consensus in defining innovation in neurosurgery.

2) To understand various perspectives on what constitutes surgical innovation.

3) To understand the practical and ethical consequences of not having a standardized definition of innovation in neurosurgery.

## Introduction

A clear definition of what constitutes innovation in neurosurgery is currently lacking. The aim of this study was to investigate what neurosurgeons consider to be innovative by gathering the opinions of neurosurgeons on several hypothetical cases.

## Methods

An anonymous survey of 52 questions containing 11 hypothetical cases (Table 1) was sent to members of the Ethics Committee of the World Federation of Neurosurgical Societies (WFNS) and all individual members of the European Association of Neurosurgical Societies (EANS). For each case, respondents were asked to select their opinion via Likert scale on the statements illustrated in Figures 1 -3. Lastly, respondents were asked what type of innovation they considered each case (Figure 4). Responses were collected from November 21, 2016 to December 30,

## Results

A total of 356 of approximately 1500 (23.7%) neurosurgeons responded. Overall, there is great heterogeneity among what neurosurgeons consider innovative and what constitutes ethical misconduct. Neurosurgeons considered certain cases more innovative (=75% considered innovative), such as using an adenovirus for glioblastoma mulitiforme or deep brain stimulation for addiction. Other cases were considered less innovative (=25% considered innovative), such as a new dura substitute.

**Table 1. Case Descriptions**

| Case Number | Topic | Description |
|---|---|---|
| 1 | Dura Substitute | A patient undergoes a craniotomy for a convexity meningioma. When closing, the neurosurgeon uses a dura substitute that has never been used in patients, and the only safety and efficacy data available are from animal studies |
| 2 | Supramaximal Resection | A patient with recurrent high-grade glioma presents for surgery. The surgeon uses a supra-maximal technique for resection, removing all of the contrast-enhancing tissue as well as some surrounding tissue, with the hope of delaying or preventing recurrence or tumor progression. |
| 3 | New Vascular Balloon Device | A patient presents with carotid stenosis and a family history of stroke. Instead of undergoing a carotid endarterectomy, the patient is treated with balloon angioplasty. This is the first time this device will be used in patients. |
| 4 | Endoscopic Third Ventriculostomy | A patient requires endoscopic third ventriculostomy. During the case, the surgeon employs the use of a new catheter to create the opening in the floor of the third ventricle. This catheter has been used for other indications. |
| 5 | Laser resection of meningioma | A surgically-accessible meningioma is resected using a thulium laser instead of traditional resection. The laser has been used for other indications in humans, however not for this purpose. |
| 6 | Focused Ultrasound | A patient presents with a skull-base meningioma. Rather than attempting traditional resection, the surgeon employs focused ultrasound therapy. |
| 7 | Virus for GBM | A patient with glioblastoma multiforme (GBM) undergoes surgical resection. Following resection, the tumor cavity is injected with modified adenovirus in an attempt to stimulate the host immune system against any remaining GBM cells. |
| 8 | DBS for Addiction | A patient with a 10-year history of opioid addiction presents for therapy. The surgeon decides to use DBS to stimulate the nucleus accumbens, in the hope of alleviating the patient's addiction. |
| 9 | New Pedicle Screws | A patient requires lumbar laminectomy and fusion. The surgeon uses new pedicle screws that are claimed to reduce post-operative pain. |
| 10 | Photodynamic Therapy | A patient presents with an irresectable malignant glioma. A biopsy using 5-ALA is performed. Upon biopsy, the surgeon leaves a light source in place for a few days with the aim to kill remaining tumor cells. |
| 11 | New High-Speed Drill | A patient requires a transsphenoidal approach for resection of a pituitary adenoma. During the opening of the sella, the surgeon uses a new drill whose manufacturers claim it reduces the risk of lesioning the surrounding structures. |

**Figure 1. This case is an example of innovation in neurosurgery.**

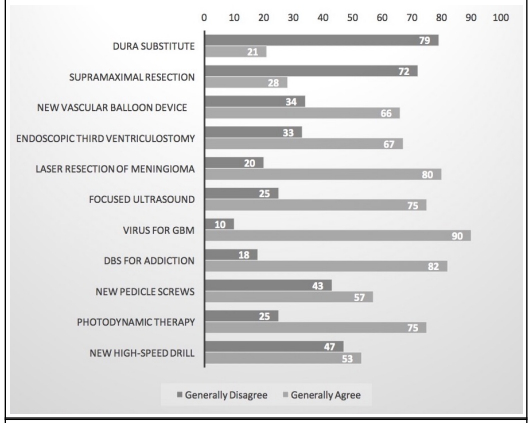



**Figure 2. By not having obtained some sort of approval form the IRB or an innovation commitee for this case, the neurosurgeon vioalted ethical standards.**

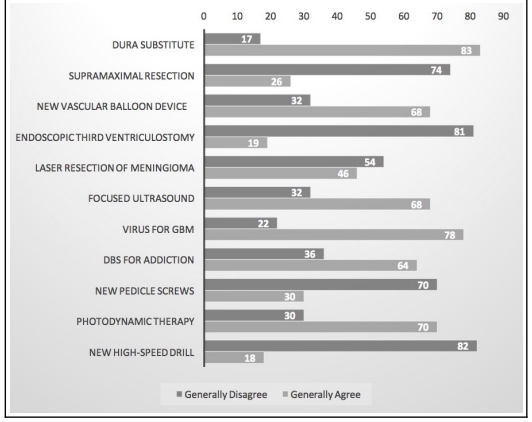



**Figure 3. Advancing the field of neurosurgery was valued more than individual patient care.**

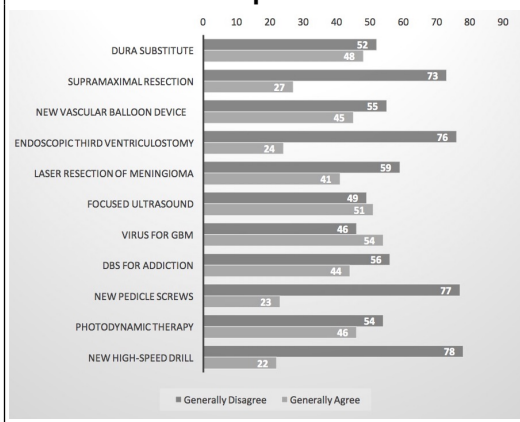
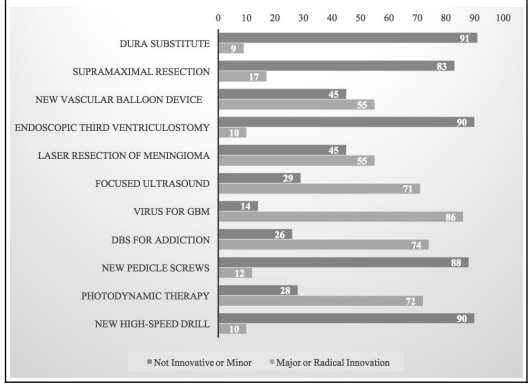



**Figure 4. What type of innovation is this?**




## Conclusions

Neurosurgeons lack a clear definition of innovation. This lack of consensus poses practical and ethical concerns relevant to appropriate oversight of innovative procedures. In the future, appropriate steps should be taken to define innovation in neurosurgery so that neurosurgeons can use innovation to advance the field of neurosurgery without compromising patient safety.