Stereotact Funct Neurosurg 2012;90:8

DOI: [10.1159/000334675](https://doi.org/10.1159/000334675)

Disruptive Innovation Concept

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The concept of disruptive innovation is essentially a more reserved term for what could possibly be called 'revolutionization' of the field. In fact, successful 'disruptions' translate into revolutionary breakthroughs, while unsuccessful ones disappear and are forgotten.

Similar to radiosurgery, endovascular treatment of aneurysms and arteriovenous malformations (AVMs), another example of disruptive innovation, was considered a 'heresy' by many 'traditional' surgeons. Even now, with wide acceptance of aneurysm coiling and AVM embolization, the endovascular field is fighting to prove the superiority of stenting to open carotid interventions.

The strict definition of disruptive innovation as comparable in terms of effectiveness but cheaper in terms of cost and safer in terms of morbidity does not always hold true – an example being the introduction of deep brain stimulation (DBS) that almost completely replaced lesioning in the treatment of movement disorders but was not able to eliminate all risks. The cost of such surgery skyrocketed – from minimal expense of thalamotomy and pallidotomy, we are now talking about tens of thousands of dollars associated with DBS equipment.

The same is true with cancer pain: our generation-long experience with cordotomies has been pretty much forgotten with the introduction of intrathecal pumps, the safer and convenient but significantly more expensive alternative. Here, one of the reasons for the steady promotion of such 'disruptive' innovation was the strong support of the device manufacturing industry – and just as Medtronic and others were (are) promoting pumps and stimulators, Elekta and linear accelerator companies were supporting stereotactic radiosurgery (SRS), a detail that was omitted in this paper's discussion [1].

One may notice that innovation goes through a path of trial and error. If it were not for its effectiveness in the treatment of vestibular schwannomas, the visibility and acceptance of SRS would not be where they are today. With respect to the initial intention of Prof. Leksell, the original indications for SRS became reality only partially: designed for functional work, SRS is still a very much accepted modality (albeit much less effective than other surgical interventions) for the treatment of trigeminal neuralgia, but less useful for other functional interventions where early attempts to popularize SRS thalamotomy and pallidotomy failed to gain any meaningful acceptance. This, however, may still

change, as advances in imaging with precise functional localization of physiological targets may replace our current intraoperative neurophysiological testing; but even then, the trend away from destructive surgery may limit functional SRS applications to certain indications where neuromodulation is less appealing (such as SRS capsulotomy for refractory OCD) or when neuromodulation fails.

Another example of a less successful (unsuccessful) attempt to 'disrupt' our practice was the introduction of surgical lasers. Although initially proclaimed as an instrument that will replace mechanical cutting, the approach did not become widely accepted, and further attempts to use lasers to shrink and coagulate the disk tissue to alleviate chronic back pain fell into oblivion along with chymopapain, intradiscal electrothermal annuloplasty, percutaneous arthroscopic discectomy and many other interventions that had great promise but did not deliver expected results.

Nevertheless, the concept of disruptive innovation is indeed valid, and we will see more of it as time goes on and technology evolves. As the matter of fact, even the 'disruption' itself has already been 'disrupted' from inside, as the introduction of frameless SRS in CyberKnife has become a major 'disruption' and a source of 'turf war' with more established frame-based approaches within the SRS field.

So, what will be the next 'disruption'? Will it be the acceptance of viral vectors or stem cells replacing 'established' neurosurgical approaches? Will that be driven by change of treatment paradigms where radiation, medications or electricity change the behavior of biological tissue – such as 'non-destructive pulsed radio-frequency' that is considered by some as neuromodulation, or such as the use of electricity in the treatment of brain tumor similar to the 'tumor-treating field therapy' that just recently received regulatory approval in the US?

The excitement of being part of an innovative process and the possibility for such 'disruption' to revolutionize the entire field should continue to drive neurosurgical minds and move the specialty forward. One has to understand that despite a derogatory connotation (nobody likes disruptive behavior!), disruptive innovation is probably the best path when it comes to medical – and neurosurgical – progress.

Reference

- 1 Niranjan A, Madhavan R, Gerszten PC, Lunsford LD: Intracranial radiosurgery: an effective and disruptive innovation in neurosurgery. *Stereotact Funct Neurosurg* 2012;90:1–7.

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