

The Evolution of Our Journal *Stereotactic and Functional Neurosurgery*: From 1938 until Now and Beyond

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Our journal was born *Confinia Neurologica* in 1938, the creation of Ernest Spiegel who served as the first editor (Fig. 1). The journal name changed to *Applied Neurophysiology* in 1975 with volume 38. The title transitioned to the current title *Stereotactic and Functional Neurosurgery* with volume 52 in 1989. The journal was often linked to functional neurosurgery congresses publishing proceedings and abstracts of several meetings starting with the 1st International Symposium on Stereoecephalotomy held in 1961.

The journal editors transitioned from Dr. Ernest Spiegel (1938–1974) to Dr. Philip Gildenberg (1975–2001) and Dr. David Roberts (2002–2020). These remarkable individuals maintained the journal through the birth, adolescence, temporary decline, and renaissance of functional neurosurgery, keeping a steady course through the periods of highs and lows experienced in our specialty.

I now have the honor of being chosen the Editor-in-Chief of *Stereotactic and Functional Neurosurgery* as of July 1, 2020. I am very grateful for the great care, scientific acumen, and dedication of Dr. Roberts over the last two decades and his excellent ongoing mentorship in passing the baton.



Dr. Andres Lozano, Editor-in-Chief

Transitions are opportunities to reflect on the past and chart a course for the future. Before one embarks on such an adventure, it is also useful to make an appraisal of the state of affairs. I will start by surveying the works published and the impact of the papers published in this journal since its inception.

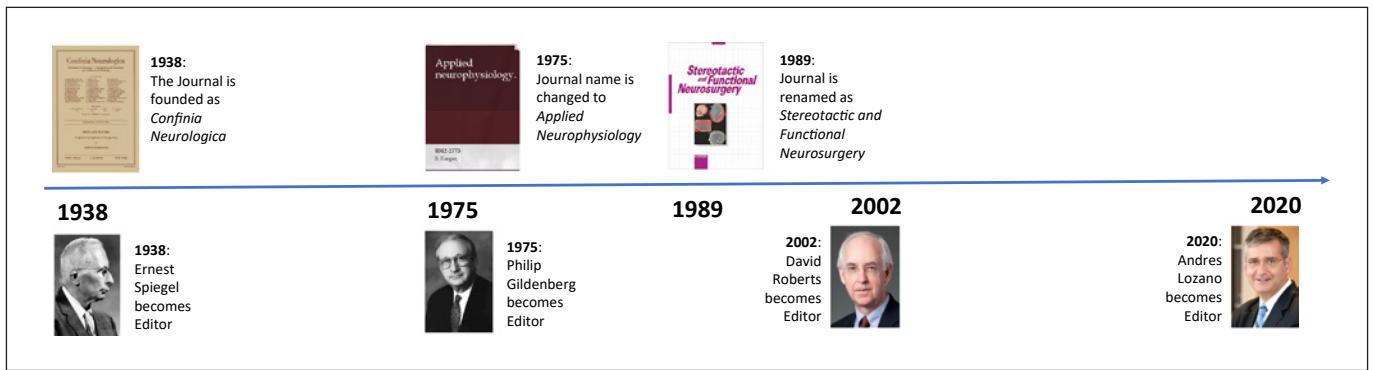


Fig. 1. Historical timeline of the journal and its editors showing years of founding and name changes of the journal as well as the four editors to date.

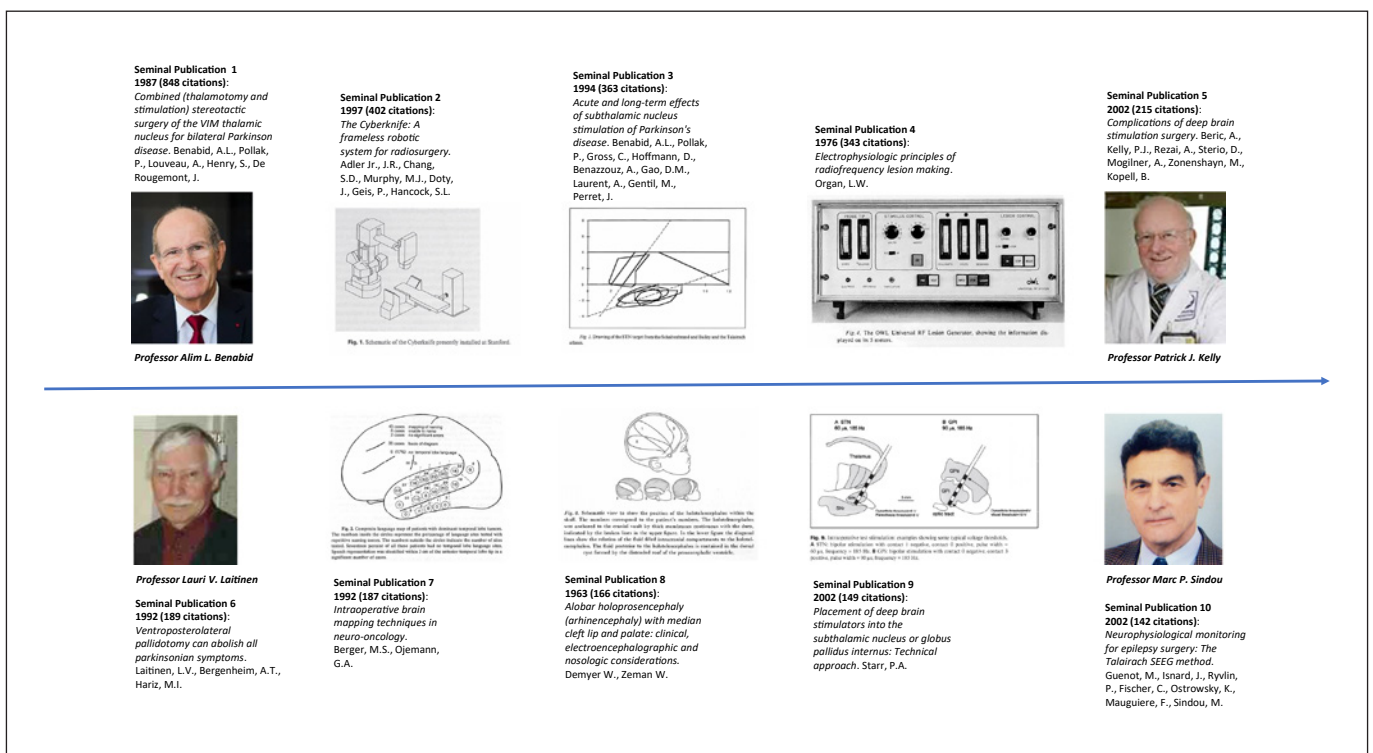


Fig. 2. The top 10 most cited publications in our journal. 10 seminal publications in *Stereotactic and Functional Neurosurgery* (and *Applied Neurophysiology* or *Confinia Neurologica*) that received the highest number of total citations.

First, I made a survey of the most influential papers published in *Stereotactic and Functional Neurosurgery* as gauged by the number of times those works were cited by other authors. A list of the rankings is seen in Table 1. The most highly cited paper is the breakthrough paper of thalamic deep brain stimulation (DBS) for tremor by Benabid et al. [1] in 1987 that received 848 citations. The introduction of levodopa in the 1960s had dampened Par-

kinson surgery, while the availability of chlorpromazine and the societal backlash against psychiatric surgery ground these procedures to a halt. More than anything, this pioneering work of DBS for tremor published in our journal ushered a reawakening of the interest in functional neurosurgery, spearheaded by the increasing use and later widespread adoption of DBS. As can be seen in the top 10 most cited publications (Fig. 2), topics related not

Table 1. The top 50 most cited works appearing in *Confinia Neurologica* (CN), *Applied Neurophysiology* (AN), or *Stereotactic and Functional Neurosurgery* (SFN) as of June 9, 2020

Rank	Citations	Authors	Title	Journal	Year	Volume	Pages
1	848	Benabid AL, Pollak P, Louveau A, Henry S, De Rougemont J	Combined (thalamotomy and stimulation) stereotactic surgery of the VIM thalamic nucleus for bilateral Parkinson disease	SFN	1987	50	344–346
2	402	Adler JR Jr, Chang SD, Murphy MJ, Doty J, Geis P, Hancock SL	The Cyberknife: a frameless robotic system for radiosurgery	SFN	1997	69	124–128
3	363	Benabid AL, Pollak P, Gross C, Hoffmann D, Benazzouz A, Gao DM, Laurent A, Gentil M, Perret J	Acute and long-term effects of subthalamic nucleus stimulation of Parkinson's disease	SFN	1994	62	76–84
4	343	Organ LW	Electrophysiologic principles of radiofrequency lesion making	AN	1976	32	69–76
5	215	Beric A, Kelly PJ, Rezai A, Sterio D, Mogilner A, Zonenshayn M, Kopell B	Complications of deep brain stimulation surgery	SFN	2002	77	73–78
6	189	Laitinen LV, Bergenheim AT, Hariz MI	Ventroposterolateral pallidotomy can abolish all parkinsonian symptoms	SFN	1992	58	14–21
7	187	Berger MS, Ojemann GA	Intraoperative brain mapping techniques in neuro-oncology	SFN	1992	58	153–161
8	166	Demyer W, Zeman W	Alobar holoprosencephaly (arhinencephaly) with median cleft lip and palate: clinical, electroencephalographic and nosologic considerations	CN	1963	23	1–36
9	149	Starr PA	Placement of deep brain stimulators into the subthalamic nucleus or globus pallidus internus: technical approach	SFN	2002	79	118–145
10	142	Guenot M, Isnard J, Ryvlin P, Fischer C, Ostrowsky K, Manguiere F, Sindou M	Neurophysiological monitoring for epilepsy surgery: the Talairach SEEG method. StereoElectroEncephaloGraphy. Indications, results, complications and therapeutic applications in a series of 100 consecutive cases	SFN	2002	77	29–32
11	139	Hamani C, Lozano AM	Hardware-related complications of deep brain stimulation: a review of the published literature	SFN	2006	84	248–251
12	138	Kihlstrom L, Karlsson B, Lindquist C	Gamma Knife surgery for cerebral metastases. Implications for survival based on 16 years experience	SFN	1993	61	45–50
13	135	Hariz MI, Shamsgovara P, Johansson F, Hariz GM, Fodstad H	Tolerance and tremor rebound following long-term chronic thalamic stimulation for parkinsonian and essential tremor	SFN	1999	72	208–218
14	130	Norén G	Long-term complications following Gamma Knife radiosurgery of vestibular schwannomas	SFN	1998	70	65–73
15	124	Hariz MI, Fodstad H	Do microelectrode techniques increase accuracy or decrease risks in pallidotomy and deep brain stimulation? A critical review of the literature	SFN	1999	72	157–169
16	122	Chkhenkeli SA, Chkhenkeli IS	Effects of therapeutic stimulation of nucleus caudatus on epileptic electrical activity of brain in patients with intractable epilepsy	SFN	1997	69	221–224
17	112	Lindquist C, Kihlström L, Hellstrand E	Functional neurosurgery – a future for the Gamma Knife?	SFN	1991	57	72–81
18	112	Benton AL	Constructional apraxia and the minor hemisphere	CN	1967	29	1–16

Table 1 (continued)

Rank	Citations	Authors	Title	Journal	Year	Volume	Pages
19	111	Bjartmarz H, Rehncrona S	Comparison of accuracy and precision between frame-based and frameless stereotactic navigation for deep brain stimulation electrode implantation	SFN	2007	85	235–242
20	109	Khan MF, Mewes K, Gross RE, Škrinjar O	Assessment of brain shift related to deep brain stimulation surgery	SFN	2007	86	44–53
21	109	Garcia-Larrea L, Peyron R, Mertens P, Grégoire MC, Lavenne F, Bonnefoi F, Mauguière F, Laurent B, Sindou M	Positron emission tomography during motor cortex stimulation for pain control	SFN	1997	68	141–148
22	108	Tasker RR, Siqueira J, Hawrylyshyn P, Organ LW	What happened to VIM thalamotomy for Parkinson's disease?	SFN	1983	46	68–83
23	106	Benabid AL, Cinquin P, Lavalle S, Le Bas JF, Demongeot J, De Rougemont J	Computer-driven robot for stereotactic surgery connected to CT scan and magnetic resonance imaging. Technological design and preliminary results	SFN	1987	50	153–154
24	105	North RB, Kidd DH, Lee MS, Piantodosi S	A prospective, randomized study of spinal cord stimulation versus reoperation for failed back surgery syndrome: initial results	SFN	1994	62	267–272
25	102	Salgado S, Kaplitt MG	The nucleus accumbens: a comprehensive review	SFN	2015	93	75–93
26	102	Fountas KN, Smith JR, Murro AM, Politsky J, Park YD, Jenkins PD	Implantation of a closed-loop stimulation in the management of medically refractory focal epilepsy: a technical note	SFN	2005	83	153–158
27	102	Siegfried J, Lippitz B	Chronic electric stimulation of the VL-VPL complex and of the pallidum in the treatment of movement disorders: personal experience since 1982	SFN	1994	62	71–75
28	101	Long DM, Erickson D, Campbell J, North R	Electrical stimulation of the spinal cord and peripheral nerves for pain control: a 10-year experience	SFN	1981	44	207–217
29	100	Hariz MI	Safety and risk of microelectrode recording in surgery for movement disorders	SFN	2002	78	146–157
30	100	Ganz JC, Backlund EO, Thorser FA	The effects of Gamma Knife surgery of pituitary adenomas on tumor growth and endocrinopathies	SFN	1993	61	30–37
31	99	Berman BD, Starr PA, Marks WJ Jr, Ostrem JL	Induction of bradykinesia with pallidal deep brain stimulation in patients with cranial-cervical dystonia	SFN	2009	87	37–44
32	99	Binder DK, Rau G, Starra PA	Hemorrhagic complications of microelectrode-guided deep brain stimulation	SFN	2003	80	28–31
33	99	Kondziolka D, Whiting D, Germanwala A, Oh M	Hardware-related complications after placement of thalamic deep brain stimulator systems	SFN	2002	79	228–233
34	99	Davis R, Emmonds SE	Cerebellar stimulation for seizure control: 17-year study	SFN	1992	58	200–208
35	99	Cooper IS, Upton ARM, Amin I	Reversibility of chronic neurologic deficits. Some effects of electrical stimulation of the thalamus and internal capsule in man	SFN	1980	43	244–258
36	98	Lim YJ, Leem W, Kim TS, Rhee BA, Kim GK	Four years' experiences in the treatment of pituitary adenomas with Gamma Knife radiosurgery	SFN	1998	70	95–109
37	98	Talairach J, Bancaud J	Lesion, "irritative" zone and epileptogenic focus	CN	1966	27	91–94
38	96	Bowman BR, McNeal DR	Response of single alpha motoneurons to high-frequency pulse trains: firing behavior and conduction block phenomenon	SFN	1986	49	121–138

Table 1 (continued)

Rank	Citations	Authors	Title	Journal	Year	Volume	Pages
39	94	Young RF, Vermeulen S, Posewitz A	Gamma Knife radiosurgery for the treatment of trigeminal neuralgia	SFN	1998	70	192–199
40	93	Gao G, Wang X, He S, Li W, Wang Q, Liang Q, Zhao Y, Hou F, Chen L, Li A	Clinical study for alleviating opiate drug psychological dependence by a method of ablating the nucleus accumbens with stereotactic surgery	SFN	2003	81	96–104
41	93	Regis J, Peragut JC, Rey M, Samson Y, Levriei O, Porcheron D, Regis H, Sedan R	First selective amygdalohippocampal radiosurgery for “mesial temporal lobe epilepsy”	SFN	1995	64	193–201
42	93	Barolat G, Schwartzman R, Woo R	Epidural spinal cord stimulation in the management of reflex sympathetic dystrophy	SFN	1989	53	29–39
43	91	Rahmathulla G, Recinos PF, Valerio JE, Chao S, Barnett GH	Laser interstitial thermal therapy for focal cerebral radiation necrosis: a case report and literature review	SFN	2012	90	192–200
44	91	Hariz MI, Krack P, Melvill R, Jorgensen JV, Hamel W, Hirabayashi H, Lenders M, Wesslen N, Tengvar M, Yousry TA	A quick and universal method for stereotactic visualization of the subthalamic nucleus before and after implantation of deep brain stimulation electrodes	SFN	2003	80	96–101
45	91	Steinmeier R, Rachinger J, Kaus M, Ganslandt O, Huk W, Fahlbusch R	Factors influencing the application accuracy of neuronavigation systems	SFN	2000	75	188–202
46	90	Pepper J, Zrinzo L, Mirza B, Foltynie T, Limousin P, Hariz M	The risk of hardware infection in deep brain stimulation surgery is greater at impulse generator replacement than at the primary procedure	SFN	2013	91	56–65
47	90	Hosobuchi Y	Electrical stimulation of the cervical spinal cord increases cerebral blood flow in humans	SFN	1985	48	372–376
48	89	Rasmussen T	Further observations on the syndrome of chronic encephalitis and epilepsy	AN	1978	41	1–12
49	89	Munding F	Stereotaxic interventions on the zona incerta area for treatment of extrapyramidal motor disturbances and their results	CN	1965	26	222–230
50	88	Heikkinen ER, Konnov B, Melnikov L, Yalynych N, Zubkov YN, Garmashov YA, Pak VA	Relief of epilepsy by radiosurgery of cerebral arteriovenous malformations	SFN	1989	53	157–166

Table 2. The top 10 contributing authors in our journal as of June 9, 2020

Rank	Author	Citations
1	Ohye, Chihiro	43
2	Spiegel, Ernest A.	35
3	Nashold, Blaine S.	33
4	Gildenberg, Philip L.	31
5	Tasker, Ronald R.	29
6	Lunsford, L. Dade	28
7	Kondziolka, Douglas	27
8	Taira, Takaomi	25
9	Hariz, Marwan I.	23
10	Krauss, Joachim K.	22

only to DBS but also to the reintroduction of pallidotomy by Laitinen et al. [2], techniques of radiosurgery [3], mapping [4], lesioning [5], and stereoelectroencephalography [6]. At number 5 is an overview of the complications of DBS [7], reflecting the large interest in the adverse events related to surgical procedures in our field and our constant striving toward improvements. These are the principal technological and scientific developments that have been and are currently driving our field.

I next looked at the top 10 contributing authors to our journal (Table 2; Fig. 3). Prof. Chihiro Ohye was a pioneer in microelectrode mapping and in gamma knife thalamotomy, and he claims the top contributing author position with 43 papers. His exquisite mapping of thalamic motor

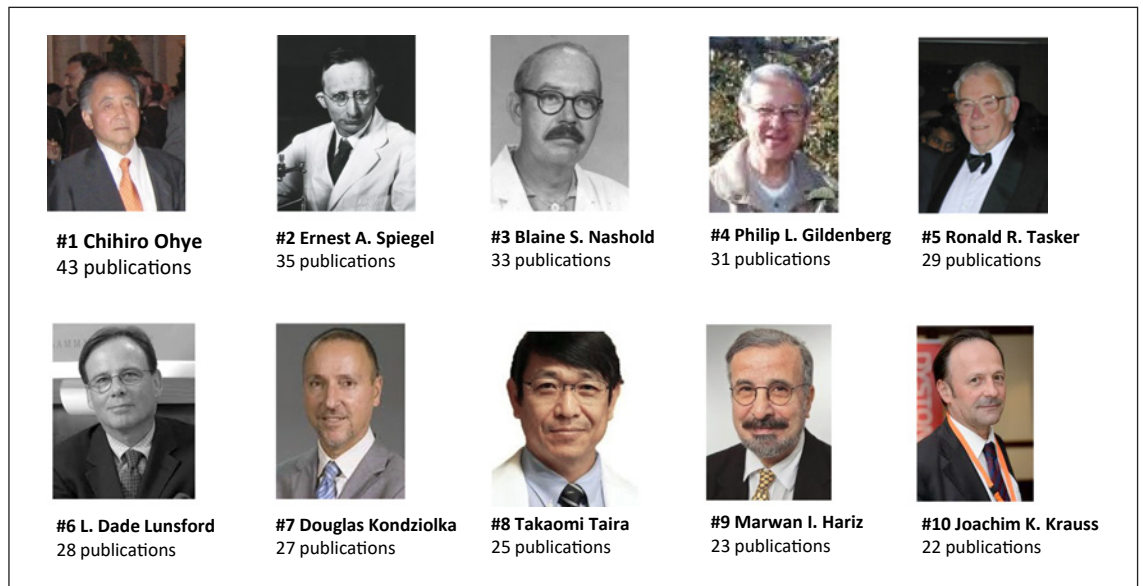


Fig. 3. The top 10 contributing authors in our journal as ranked by total number of publications in *Stereotactic and Functional Neurosurgery* (and *Applied Neurophysiology* and *Confinia Neurologica*) since 1938.

neurons and the elegant neurophysiology that he illustrated seems at first perhaps at odds with his adoption of gamma knife thalamotomy without physiological mapping later in his career. One can only surmise that his detailed knowledge of the motor thalamus gave him unique knowledge and credentials to make this transition. The author with the second most contributions to our journal was its founder, Dr. Ernest Spiegel from Philadelphia, with 35 papers. With their seminal publication in *Science* in 1947 [8], Spiegel and his neurosurgical colleague Dr. Henry Wycis are considered the fathers of the modern era of human frame-based stereotactic neurosurgery. Spiegel was a brilliant neurologist whose work focused on brain mapping and lesioning surgery in deep brain targets, pioneering many novel procedures in the fields of movement and psychiatric disorders. The third-ranked contributor was Dr. Blaine Nashold from Duke University, who contributed 33 papers in his area of expertise, ablative procedures in the spinal cord and brain stem for pain. Together with Dr. Marc Sindou, Blaine Nashold is considered the discoverer of the dorsal root entry zone ablation procedure for pain and spasticity. Next came Dr. Philip Gildenberg who ranks number 4 and contributed 31 papers focusing on the technological advances in functional neurosurgery. Dr. Gildenberg had a keen interest in technology and was interested in all aspects of functional neurosurgery, including spinal cord stimulation, neural navigation, robotics, scholarly publications, and history. He was both editor of

our journal and led major societies in our discipline as president of both the American and the World Societies of Stereotactic and Functional Neurosurgery (ASSFN and WSSFN). At number 5 with 29 papers is Dr. Ronald Tasker, my mentor from Toronto, who specialized in microelectrode recordings and mapping. Dr. Tasker was the premiere cartographer of the human brain and brainstem. His major contributions have gone beyond neurophysiological mapping to make advances in the understanding and treatment of pain and movement disorders and in mentoring the new generation of functional neurosurgeons who now lead programs throughout the world. Next at number 6 and 7 are two active neurosurgeons from Pittsburgh, Dr. Dade Lunsford with 28 papers and Dr. Douglas Kondziolka (now in New York) with 27 papers. They are credited with introducing and pioneering the development of gamma knife radiosurgery and its successful migration from Europe to North America. Dr. Takaomi Taira, a talented functional neurosurgeon who trained with Dr. Ted Hitchcock in Birmingham and who works in Tokyo, contributed 25 papers mostly in his areas of expertise which include thalamotomy and the surgical treatment of dystonia. Dr. Taira was an excellent president of the WSSFN from 2009 to 2013. Dr. Marwan Hariz from Sweden, Queen's Square, and now again Sweden contributed 23 papers on a variety of subjects, but the most cited ones are in the realm of pallidotomy that he resurrected as a student of Dr. Lauri Laitinen. Dr. Joachim Krauss of

Table 3. The top 10 countries of origin of publications in our journal as of June 9, 2020

Rank	Country of origin	Publications
1	United States	1,237
2	Japan	282
3	Switzerland	220
4	Germany	179
5	France	164
6	Canada	126
7	United Kingdom	125
8	Italy	110
9	Sweden	91
10	China	89

Table 4. The top 10 institutions by number of publications in our journal as of June 9, 2020

Rank	Institution	Publications
1*	University of California, San Francisco	41
1*	University of Toronto	41
3	Tokyo Women's Medical University	39
4	Duke University Medical Center	34
5	Cleveland Clinic Foundation	33
6	University of Pittsburgh	30
7	Mayo Clinic	29
8*	Gunma University Faculty of Medicine	28
8*	Harvard Medical School	28
10	UPMC Presbyterian	27

*Tied at number 1 and 8, respectively.

Hannover, also a past president of the WSSFN, rounds up the top 10 contributors with 22 papers. His contributions were principally in the realm of surgery for dystonia, and he continues as a strong leader in science, innovation, and education in our field.

When looking at the top 10 countries of origin of papers published in our journal (Table 3), one can see that the United States with 1,237 has contributed approximately four times more papers than the next country, which is Japan at 282. Switzerland, Germany, and France have papers in excess of 150 each, followed by Canada, the United Kingdom, and Italy with over 100 papers each, and then Sweden, and coming in at number 10 is China. Current trends suggest that there is an increasing number of contributions from Asia, particularly China.

With respect to institutional affiliations (Table 4), the rank of manuscript contributions based on affiliation includes the University of California, San Francisco and the

University of Toronto which are tied at number 1 with 41 publications each, followed by Tokyo Women's Medical University with 39 publications, then Duke University, Cleveland Clinic, University of Pittsburgh, and Mayo Clinic, then Gunma University and Harvard Medical School tied for 8th, and UPMC Presbyterian. These are indeed some of the most productive centers for stereotactic and functional neurosurgery in the world.

Over the last decade from 2010 to 2020, the average number of papers published in our journal is in the range of 50–70 per year and this trend has been steady for many decades now. With respect to impact factor, under the leadership of Dr. Roberts our journal has shown a steady increase, reaching 1.635 as the most recent iteration in 2019. The cite score tracker is calculated by the citation count for a particular year divided by the total number of documents in the preceding 3 years.

This is where we have been but now where are we going? The future has never been brighter. Our field is rapidly growing. The number of bright neurosurgeons gravitating to functional neurosurgery is increasing. Scientific advances in brain mapping, brain stimulation, spinal cord stimulation, focused ultrasound, gene therapy, better understanding of brain anatomical and functional connectomics and network functions are but some examples of the advances that are being made and are starting to have, in many cases, important impact in our patients. The future will usher in a new era with the full impact of minimally invasive surgery, brain machine interfaces, and molecular neurosurgery. To be able to witness these developments and serve as a living record of these events as we capture them in our journal is a tremendous opportunity and honor. I look forward to working with the stereotactic and functional neurosurgery community to record these discoveries and bring them to the forefront.

Conflict of Interest Statement

A.M. Lozano is a consultant to Abbott, Boston Scientific, INSIGHTEC, and Medtronic and is a scientific director at Functional Neuromodulation.

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