

## The AANS/CNS Section on Tumors: a summary of 40 years of advocacy to advance the care of patients with brain and spine tumors

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The AANS/CNS Section on Tumors was founded 40 years ago in 1984 to assist in the education of neurosurgeons interested in neuro-oncology, and serves as a resource for other national organizations regarding the clinical treatment of nervous system tumors. The Section on Tumors was the first national physicians' professional organization dedicated to the study and treatment of patients with brain and spine tumors. Over the past 40 years, the Section on Tumors has built solid foundations, including establishing the tumor section satellite meetings, founding the *Journal of Neuro-Oncology* (the first medical journal dedicated to brain and spine surgical oncology), advancing surgical neuro-oncology education and research, promoting neurosurgical involvement in neuro-oncology clinical trials, and advocating for patients with brain and spine tumors. This review provides a synopsis of the Section on Tumors' history, its challenges, and its opportunities, drawing on the section's archives and input from the 17 section chairs who led it during its first 40 years.

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**T**HE first impetus for organizing the Section on Tumors originated with Dr. Edward Laws in 1983. Dr. Laws was then the president-elect of the Congress of Neurological Surgeons (CNS). He suggested the need for a subspecialty section focused on brain tumors and recruited Dr. Mark Rosenblum to this effort. Dr. Rosenblum arranged for an initial planning meeting with approximately 10 prominent brain tumor surgeons over dinner at Jack's Restaurant in San Francisco during the 1983 American Association of Neurological Surgeons (AANS) meeting. This was followed by further planning meetings during the annual CNS meeting in the fall of 1983. The goal of these meetings was to establish a subspecialty group within organized neurosurgery to assist in the education of neurosurgeons in neuro-oncology and to serve as a resource for the AANS, CNS, and other national groups on the clinical treatment of and research on tumors within the category of nervous system tumors.

Looking back 40 years later, these goals seem straightforward and laudable. At the time, however, significant barriers to achieving these objectives were present. First, neuro-oncology itself was not well established as a distinct subspecialty area of clinical or research focus. Other than an informal association of investigators invited to participate in brain tumor-focused meetings like the Asilomar Conference in 1975,<sup>1</sup> no national professional organization existed that was dedicated to further the neuro-oncology care of patients and foster research on this topic. The Neuro-Oncology Section of the American Academy of Neurology was not founded until 1994 and the Society for Neuro-Oncology (SNO) was not founded until 1995. Within organized neurosurgery, support for the subspecialty was lukewarm and the fear of multiple competing organizations on the same topic was a concern, as both Dr. Mark Rosenblum and Dr. Mark Bernstein reminded us in recent correspondence. This was resolved only by includ-

**ABBREVIATIONS** AANS = American Association of Neurological Surgeons; CAST = Committee for Accreditation of Subspecialty Training; CNS = Congress of Neurological Surgeons; EC = Executive Committee; NREF = Neurosurgery Research & Education Foundation; SNO = Society for Neuro-Oncology.

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**TABLE 1. AANS/CNS sections and their year of establishment**

| Section                                    | Year  |
|--|-------|
| Pediatric Neurological Surgery             | 1972  |
| Stereotactic and Functional Surgery        | 1973  |
| Cerebrovascular                            | 1976  |
| Disorders of the Spine & Peripheral Nerves | 1979  |
| Tumors                                     | 1984  |
| Women In Neurosurgery                      | 1989* |

The AANS/CNS also has a Section on Pain and a Section on Neurotrauma & Critical Care, but the years of their founding are not readily available.

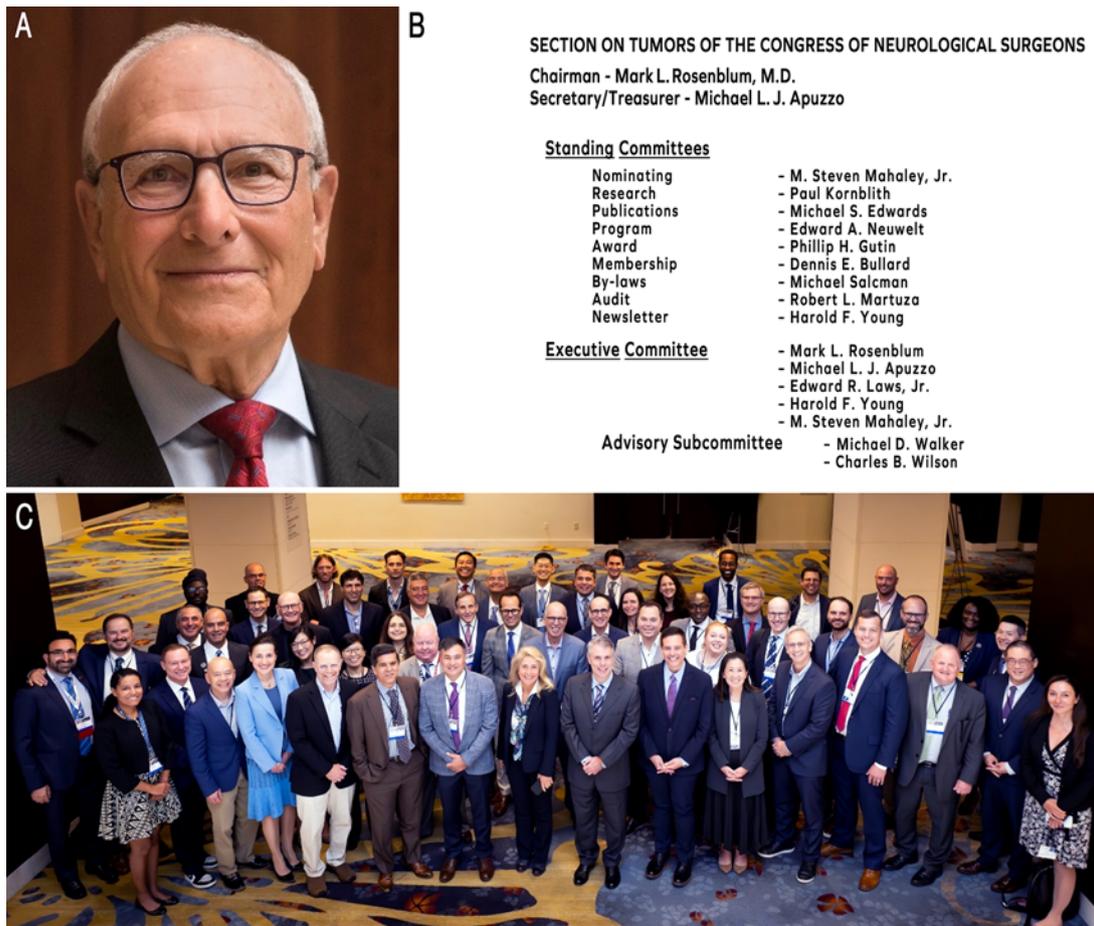
\* This was recognized as a section in 2014.

ing AANS and CNS leadership in planning and highlighting direct benefits to the parent organizations.

Within organized neurosurgery, subspecialty groups had been established within the AANS by the 1980s. The Section on Tumors was the fifth such group founded (Table 1). No others were joint sections between the CNS and AANS. Concern was present that this subspecialty was not necessarily desirable within neurosurgery and that all

neurosurgeons should do all types of cases. The possibility was raised that establishing a new subspecialty section might lead to competition with the AANS and CNS and decrease attendance at national meetings. A common bias existed in neurosurgery at the time that tumor specialists were often “just researchers” and without a subspecialty identity that served the entire field of neurosurgery. Clearly, there was a need for neuro-oncological neurosurgeons to earn credibility with national organizations and neurosurgeons in general by providing added value. Although establishing a new section on tumors might accomplish this, efforts were hampered by a complete lack of funding to support these plans.

Thankfully, enthusiasm was high among tumor neurosurgeons. The CNS and AANS both agreed to provide \$4000 loans to support the development of an affiliated neurosurgical oncology subspecialty group. In 1984, the Section on Tumors was recognized by both the CNS Executive Committee (EC) and the AANS Board of Directors, thus becoming the AANS/CNS Joint Section on Tumors. Dr. Mark Rosenblum (Fig. 1) was appointed as the first section chair, shepherding the section through its initial establishment and growth.<sup>2</sup> Other members of the first



**SECTION ON TUMORS OF THE CONGRESS OF NEUROLOGICAL SURGEONS**

Chairman - Mark L. Rosenblum, M.D.

Secretary/Treasurer - Michael L. J. Apuzzo

**Standing Committees**

- Nominating - M. Steven Mahaley, Jr.
- Research - Paul Kornblith
- Publications - Michael S. Edwards
- Program - Edward A. Neuwelt
- Award - Phillip H. Gutin
- Membership - Dennis E. Bullard
- By-laws - Michael Salzman
- Audit - Robert L. Martuza
- Newsletter - Harold F. Young

**Executive Committee**

- Mark L. Rosenblum
- Michael L. J. Apuzzo
- Edward R. Laws, Jr.
- Harold F. Young
- M. Steven Mahaley, Jr.

**Advisory Subcommittee**

- Michael D. Walker
- Charles B. Wilson

**FIG. 1. A:** Dr. Mark Rosenblum, MD; Section on Tumors founder and inaugural chair (1985–1991). © Congress of Neurological Surgeons, published with permission. **B:** Photograph of the original 1985 section's first EC roster from the section's archives. **C:** Section on Tumors EC members, 16th Tumor Symposium, held September 8–9, 2023, in Washington DC; Isabelle M. Germano, MD, MBA, section chair (2022–2024). Courtesy of the AANS/CNS Section on Tumors (B and C). Figure is available in color online only.

Section on Tumors EC included Dr. Michael Apuzzo, Dr. Edward Laws, Dr. M. Stephen Mahaley, and Dr. Harold Young. The section's rules and regulations, referred to as bylaws, were established paralleling those already existing for the Section on Cerebrovascular Surgery.

The initial activities of the Section on Tumors were directed at addressing many of the challenges identified as the section came into existence, particularly demonstrating the value of neurosurgeons subspecialized in neurosurgical oncology. Some of this was through working with the AANS and CNS to assist in brain tumor abstract review and selection and organizing clinical symposia at national meetings. Evidence of this was present by the 1985 AANS meeting, which included an afternoon session sponsored by the Section on Tumors featuring eight papers primarily focused on gliomas and reporting basic research, as well as two clinical symposia, one focused on skull base approaches and the other on glioma biology and therapy. Furthermore, as the section considered the future, its leadership agreed to plan satellite meetings on brain tumors either immediately prior to or after national neurosurgical meetings to facilitate attendance without competing with the parent organizations' meetings.

At the same time, the Section on Tumors initiated many efforts directed at supporting section members and promoting neurosurgical oncology education and research within neurosurgery. Information was widely shared at Section on Tumors EC meetings and specialty topic subcommittees were established within the EC. A Section on Tumors newsletter was created to provide information summaries of activities reviewed at EC meetings, surveys of national clinical trials, transcripts of symposia, and other information of interest to members of the section. Awards to recognize excellence in neurosurgical oncology presentations at national meetings were instituted, such as the Mahaley Clinical Research Award and the Preuss Basic Science Award.<sup>3</sup> Finally, membership was grown among AANS and CNS members and extended to residents and prominent nonneurosurgeons engaged in neuro-oncology.<sup>4</sup>

## Growth and Evolution

Initially focused on establishing the role of neurosurgical oncology, the section continued its growth and expansion over the past 40 years, always keeping the need to improve patient care, education, and research in neurosurgical oncology as its focus. In 1991, Dr. Rosenblum stepped down as the section's chair after 7 highly productive years. He was succeeded by Dr. Bullard, and chair terms were set to 2 years. Table 2 summarizes the Section on Tumors' 17 chairs over the past 40 years. Membership has expanded dramatically over time, from a few hundred initially to more than 3000 now.<sup>4</sup> Table 3 summarizes the main strategies followed by the tumor section for its growth and expansion.

## Biennial Tumor Symposia

One key goal for the tumor section since its inception was to establish satellite symposia to promote brain tumor research and education. The first Biennial Tumor Satel-

**TABLE 2. Chairs of the AANS/CNS Section on Tumors (1984–2024)**

| Chair             | Year      |
|-------------------|-----------|
| Mark Rosenblum    | 1984–1991 |
| Dennis Bullard    | 1991–1993 |
| Peter Black       | 1993–1995 |
| William Chandler  | 1995–1997 |
| Mark Bernstein    | 1997–1999 |
| Joseph Piepmeier  | 1999–2001 |
| James Rutka       | 2001–2003 |
| Raymond Sawaya    | 2003–2005 |
| Ronald Warnick    | 2005–2007 |
| Michael McDermott | 2007–2009 |
| Jeffrey Bruce     | 2009–2011 |
| Frederick Lang    | 2011–2013 |
| Frederick Barker  | 2013–2016 |
| Steven Kalkanis   | 2016–2018 |
| Manish Aghi       | 2018–2020 |
| Jason Sheehan     | 2020–2022 |
| Isabelle Germano  | 2022–2024 |

lite Symposium was organized in 1994 during Dr. Peter Black's chairmanship.<sup>4</sup> Sixteen symposia have been held in total, including the most recent one in Washington, DC, on September 8 and 9, 2023. The Section on Tumors symposia have been mentioned as a key success during their tenure by every chair since 1992. These meetings feature prominent keynote speakers in neuro-oncology, original clinical and translational research, and peer-reviewed presentations. Occasionally, the Section on Tumors has sponsored symposia in association with other organizations including the American Association for Cancer Research (AACR, 1997) or the SNO (2011) either as independent events or as part of the Biennial Tumor Satellite Symposia in 2011 under the leadership of Dr. Frederick Lang. Fundraising generated with these symposia been a key part of the tumor section's support for brain tumor research and education.

**TABLE 3. The Section on Tumors over the years: main growth and expansion strategies**

| General Strategies                    | Collaboration w/in National Organized Neurosurgery                    |
|---------------------------------------|---|
| Abstract reviews, AANS/CNS meetings   | Clinical trial cooperative groups & national neurosurgical registries |
| Biennial symposia                     | NREF  |
| <i>Journal of Neuro-Oncology</i>      | CAST  |
| Section logo                          | Washington Committee  |
| Membership benefits                   | Coding and Reimbursement Committee                                    |
| Collaboration w/ international groups | Joint Guidelines Review Committee                                     |
| Social media presence                 |   |

## Journal of Neuro-Oncology

The *Journal of Neuro-Oncology* was created in 1983 and was the first medical journal dedicated specifically to the study of nervous system tumors, predating *Neuro-Oncology* (founded in 1999) by 16 years. Indeed, it was a critical part of the growth of neuro-oncology as a subspecialty. Since its inception, the *Journal of Neuro-Oncology* has been the tumor section's official journal, although more recently it also represents other organizations. Dr. Joseph Piepmeier (1983–2015), Dr. Linda Liau (2015–2020), and Dr. Jason Sheehan (2020–present), prominent members of the tumor section, served as editors.

## Section's Logo

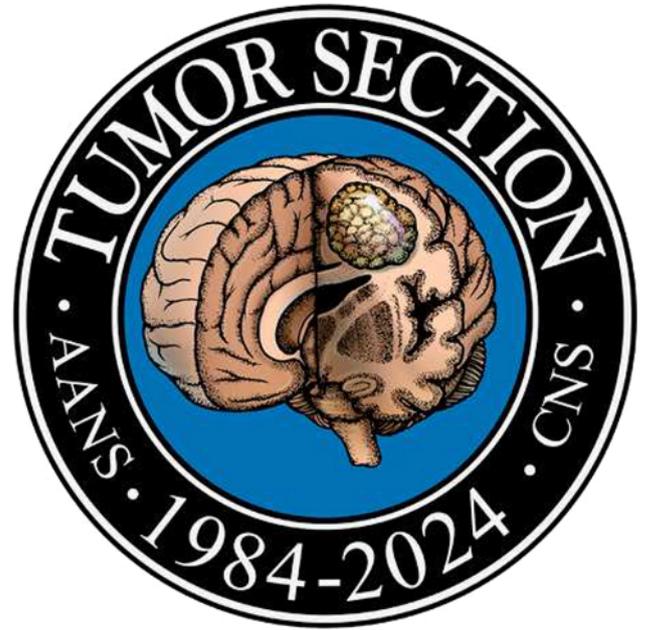
At the turn of this century, the role of neurosurgical oncologist to treat spine tumor was further recognized by the section. This prompted a change in its logo to include the brain and the spine. The current section logo designed by Ian Suk at MD Anderson Cancer Center was adopted early in the new millennia under the auspices of Section Chairs Dr. James Rutka and Dr. Raymond Sawaya. It was updated in 2004 with the addition of color by Martha Headworth at Mayfield Clinic for digital use and to commemorate special occasions like the 20th and 40th anniversaries (Fig. 2).

## Membership Benefits

A major portion of the tumor section's activities have involved defining the role of the neuro-oncological neurosurgeons within the broader worlds of both neurosurgery and neuro-oncology. Initial efforts spanning the chairmanships of Drs. Rosenblum, Bullard, and Black focused on continuing to establish the benefits of neurosurgical subspecialization in neuro-oncology. The depth and breadth of neurosurgical disorders falling under the heading of "neuro-oncology" expanded beginning with Dr. Black's tenure, with increasing recognition of benign tumors and coordination of efforts with other subspecialties (e.g., skull base, spine, pediatrics). Expanding activity in neuro-oncology over the past 40 years has not been limited to neurosurgeons or to the Section on Tumors. The SNO, which was established in 1995, has grown exponentially, and so has the CNS subcommittee of the American Society for Clinical Oncology (ASCO). Within its members, the section continues to update membership benefits that fits the needs its membership including reduced fees to educational program, free access to the *Journal of Neuro-Oncology*, opportunities for awards, national recognition, and networking.

## Collaborative Efforts With National Organized Neurosurgery

Increased neurosurgical participation in and leadership of clinical trials has been a priority, with tumor section representatives participating or leading multiple clinical trial efforts through the Alliance for Clinical Trials in Oncology, the North American Brain Tumor Consortium, the Radiation Therapy Oncology Group (RTOG), the Glioblastoma Therapeutics Network, and SNO. Section efforts for education in neurosurgical oncology have expanded including increased fellowship funding in part-



**FIG. 2.** 40th Anniversary Section on Tumors logo designed to illustrate its mission: "To provide a forum for education and research on tumors of the nervous system. To coordinate activities and programs relating to tumors for the AANS and CNS and other societies, committees and agencies. To represent the AANS and CNS when requested by executive action, at any organization or group on matters relating to tumors. To advise the AANS and the CNS of activities which relate to nervous system tumors by other individuals, groups and/or agencies." Courtesy of the AANS/CNS Section on Tumors. Figure is available in color online only.

nership with the Neurosurgery Research & Education Foundation (NREF). Drs. Steven Kalkanis, Jeffrey Olson, and other section members have played critical roles in developing guidelines for multiple cranial and spinal tumors on behalf of the tumor section. Section members have been critical in collaborating with multiple national outcomes databases including the Quality Outcomes Database (QOD) by the NeuroPoint Alliance (NPA), and the AANS Stereotactic Radiosurgery Registry. In collaboration with the Society of Neurological Surgeons (SNS), the Section on Tumors has developed curricula for training in neurosurgery oncology and skull base subspecialties through Committee for Accreditation of Subspecialty Training (CAST)-accredited fellowships. Following the original mission of its founders, the section has been actively involved in supporting research by partnering with the NREF and facilitating new partnerships with other not-for-profit organizations. Finally, the section is actively involved with the Washington Committee and Coding and Reimbursement committee to ensure advocacy for brain and spine tumor patients and their doctors.

## Collaborative Efforts With International Organized Neurosurgery

The Section on Tumors' horizons have grown substantially in its first 40 years. Although it was initially conceived as a national organization within the United States, international representation in the tumor section expanded

considerably under the leadership of Drs. Ron Warnick, Michael McDermott, and Jeffrey Bruce.

### Establishment of Social Media Presence

Finally, the tumor section has seen a dramatic growth of its online presence through its website,<sup>5</sup> social media feeds, and detailed newsletter.<sup>6</sup>

### Managing the Unexpected

As with any organization that has existed for multiple decades, the Section on Tumors has had to respond to unexpected tragedies and challenges unrelated to its primary mission. Like the rest of the country, the tumor section under Dr. James Rutka's leadership had to adapt to a very different world after the 9/11 attacks. Similarly, the COVID-19 pandemic forced many changes to the tumor section beginning in 2020. Some were lamentable, like the inability to meet in person for a time, and have thankfully passed. Other changes that came rapidly during this time—like increased virtual and web-based options for education—have brought unexpected benefits, expanding the section's reach. Some tragedies have more personal impact on the tumor section as well. Early on, the section was rocked by the death of one of its founders, Dr. M. Stephen Mahaley, in 1992, and in 2015 by its incoming Chair, Dr. Andrew Parsa. Both leaders are now memorialized in awards and fellowships sponsored by the section—the Rosenblum-Mahaley Clinical Research Award and the Andrew Parsa NREF Fellowship—under Dr. Frederick Barker's leadership.

### The Tumor Section Now

The Section on Tumors serves its members by delivering action items aligned to the section's mission. Its structure consists of its officers, the advisory board, and the EC. On the EC there are 20 chairs of subcommittees and 6 liaisons (Table 4). Each subcommittee has a chair, a cochair, and members.<sup>7</sup> The subcommittees' mission statements and deliverables are summarized in the section's Standard Operating Procedures document (Supplemental Appendix 1), and it includes the items delivered by each subcommittee for the period 2022–2024. While continuing to pursue the previous successful strategies, the section's strategies for continued growth have recently expanded (Table 4).

### Awards

The section currently confers more than 20 awards at each annual scientific meeting of the AANS and CNS recognizing the best presentations in a variety of neurosurgical oncology topics. The history of the section's awards until 2014 has been previously published.<sup>8</sup> Under Dr. William Chandler's leadership, the first Young Investigator Award was established as well as the first translational research award grant. A full list of all current awards is posted on the section's website (<https://www.tumorsection.org/awards2/>). The Section on Tumors joins with many generous industry partners to fund its awards and it is very grateful to each for their continued support. The

**TABLE 4. The Section on Tumors now**

|   |
|---|
| EC subcommittees                                |
| Awards  |
| Development and Partnership                     |
| History   |
| Newsletter                                      |
| Bylaws  |
| Early-Career Neurosurgeons                      |
| Innovation and Technology                       |
| Pediatrics                                      |
| Clinical Trials and Registries                  |
| Education                                       |
| <i>Journal of Neuro-Oncology</i>                |
| Research  |
| CAST Fellowships                                |
| Global Neurosurgery                             |
| Medical Oncology                                |
| Skull Base                                      |
| Communication                                   |
| Guidelines                                      |
| Membership and Membership Services              |
| Spine   |
| Current growth and expansion strategies         |
| Emphasis on talent and early talent recognition |
| Global partnerships                             |
| Diverse leadership                              |
| 1-year term for leadership roles                |
| Research  |
| Philanthropy                                    |

awards philanthropic support was reorganized under Dr. Manish Aghi's leadership.

### Talent and Early Talent Recognition

Acknowledging the importance of recognizing distance traveled, in the past 2 years the AANS/CNS Section on Tumors Neuro-Oncology Trainee Award was focused on being an award to the best scientific presentation from a rising program (defined as an institution that has received two or fewer awards since 2015). Additionally, to recognize the need to network with the next generation of neurosurgical oncology leaders, interactive online opportunities were developed to facilitate networking and recognition.<sup>9</sup> Finally, collaboration with early-career neurosurgeons interested in neurosurgical oncology has been strengthened to facilitate in-person gatherings and to recognize early talent.<sup>10–13</sup>

### Global Partnerships

Recognizing the importance of neurosurgery in global health,<sup>14</sup> our section moved from the international concept to global partnerships. Over the past year, the section partnered with the Society for Neuro-Oncology of Sub-Saharan Africa (SNOSSA); the Mexican Neurosurgery

Society; the Society for Neuro-Oncology Latin America (SNOLA); the European Association of Neurosurgical Societies (EANS); and the World Federation of Neurosurgical Societies (WFNS). to create educational offerings at combined neurosurgical meetings.

### Diverse Leadership

Neurosurgical oncology is a field that continues to attract many talented and successful individuals. Drawing on lessons from the business world, success has been tied to a diverse workforce.<sup>3</sup> Neurosurgical oncology has been a leader among the neurosurgery subspecialties in attracting a diverse workforce.<sup>10</sup> Dr. Isabelle Germano, the section's first woman chair (2022–2024), appointed more than 20 highly talented and qualified women and underrepresented minorities in medicine (URIM) to serve as chairs/co-chairs of the EC subcommittees and/or as liaisons. She also appointed Dr. Gelareh Zadeh as the 2023 16th Tumor Symposium scientific chair; Dr. Zadeh is the first woman to serve in this role.

### One-Year Leadership Term

Recognizing the growing number of talented individuals in the neurosurgical oncology field, the section worked at changing its current leadership positions from a 2-year term to 1 year. The section's new bylaws (i.e., rules and regulations) were approved by a vote by its membership and ratified by the two parent organizations in 2023.<sup>15</sup> To facilitate continuity with a more rapid turnaround, two new officer positions were created to include chair, chair-elect, treasurer, secretary, and immediate past president. Officers will start their new term each year at the conclusion of the AANS scientific meeting. The transition to the 1-year term will occur after Dr. Costas Hadjipanayis, the section's current secretary-treasurer, finishes serving in his 2-year post at the 2026 AANS meeting.

### Research and Philanthropy

The need for advancing therapeutic options for our patients with brain and spine tumors prompts our section to emphasize the support of investigators, especially those in the early stages of their career, providing extraordinary educational opportunities for neurosurgeons and supporting studies that identify links between best practices and improved outcomes in patient care. In partnership with the NREF, in 2023 the Section on Tumors sponsored five research grants.<sup>5</sup>

### Lessons Learned

There is still much to be accomplished by the Section on Tumors to benefit our patients and expand the role of neurosurgical oncology. We canvassed all prior and current tumor section chairs for their input on what were thought to be the key opportunities for the Section on Tumors going forward. Based on that input, several priorities were identified.

### Building on Our Successes

In many ways, the Section on Tumors has been a model

for how subspecialty groups can add value to larger neurosurgical organizations and to patient care in neurosurgical oncology. Building on this concept, it is important that the section remains an incubator for new initiatives and continues to expand its influence in NIH, NREF, study sections, journal editorial boards, scientific program committees, and advocacy. Expanding our multidisciplinary collaboration with key clinical and scientific societies such as SNO, American Society for Clinical Oncology, American Society for Therapeutic Radiation Oncology (ASTRO), and international neurosurgical and neuro-oncology societies is critical, potentially including efforts to produce joint guidelines. The section has had considerable success in disseminating neurosurgical oncology knowledge through the *Journal of Neuro-Oncology* and online educational efforts. These need to be continued and expanded with potential global outreach and growth of the role of the *Journal of Neuro-Oncology* as the preeminent entity for neurosurgical oncology innovations, mentorship, and the nurturing of young neurosurgeons focused on neuro-oncology.

### Promoting Novel Neurosurgery-Driven Research in Neuro-Oncology

The tumor section has been a strong advocate for neurosurgery-driven research in brain and spine oncology. This should be continued and expanded. Opportunities could include establishing standards for functional and patient-reported outcome assessment in neurosurgical oncology, developing national neurosurgical oncology–focused quality improvement databases, and increasing surgical window of opportunity trials to generate improved pharmacokinetic and pharmacodynamic data early in the development of novel brain tumor therapies.

### Expanding Education in Neurosurgical Oncology

The Section on Tumors has been shown to successfully support the training of diverse and collaborative leaders whose influence extends beyond neurosurgery. Continued support and expansion of new awards through the NREF Honor Your Mentor Funds may be an excellent mechanism for this. In addition, the section needs to promote and advocate for young and early- to midcareer neurosurgeons whose work is focused on brain and spine oncology. Finally, expanding the educational content sponsored by the Section on Tumors, especially online content, will help expand our impact on the field.

### Addressing Potential Barriers and Threats in Neurosurgical Oncology

Although the Section on Tumors can be justifiably proud of our accomplishments, potential barriers and threats to our mission exist now just as they have throughout our 40-year history. Some of these are internal to the section. For example, current section membership shows a nearly 2:1 ratio favoring academic neurosurgeons. Developing opportunities and activities relevant to neurosurgeons in private practice will be critical to maintaining a more inclusive impact for neurosurgeons in all types of settings. In contrast, some potential threats are external to

the section. For example, practice patterns in stereotactic radiosurgery are changing, with diminished neurosurgical involvement given the proliferation of frameless stereotactic radiotherapy options. There may be opportunities to re-establish neurosurgical leadership in this field through cooperation with outside groups, such as American Society for Therapeutic Radiation Oncology practice guidelines for stereotactic radiosurgery.

## Conclusions

The Section on Tumors has a rich 40-year history advocating and promoting patient care, research, and education at the highest levels in neurosurgical oncology. The section is well positioned to continue and build on this history, with exciting opportunities to expand its impact: the future is bright!

## Acknowledgments

We wish to acknowledge the Section on Tumor's members for their contributions and partnerships; the section's past chairs and its past and present EC members for their volunteerism and dedication; and the AANS/CNS staff for their diligent support. We are grateful to each of the section's past chairs who shared their biggest challenges and successes during their tenure. The AANS/CNS Section on Tumors extends its gratitude to its industry and philanthropy partners for their continued support.

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## Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

## Author Contributions

Conception and design: Parney, Warnick, Germano. Acquisition of data: Parney, Warnick, Lang, Germano. Analysis and interpretation of data: Parney, Kalkanis, Germano. Drafting the article: Parney, Warnick, Rosenblum, Germano. Critically revising the article: Parney, Warnick, Rosenblum, Germano. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Parney. Administrative/technical/material support: Kalkanis, Germano. Study supervision: Parney, Germano.

## Supplemental Information

### Online-Only Content

Supplemental material is available with the online version of the article.

*Supplemental Appendix 1*. <https://thejns.org/doi/suppl/10.3171/2023.12.JNS232781>.

## Correspondence

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