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Editorial

Welcome to the New Era of Neurosurgical Subspecialization

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Neurosurgical practices have ancient origins. However, as a subspecialty of general surgery, neurosurgery is a relatively recent development, propelled by advancing technologies in the latter half of the 19th century. The developments of anesthesia, antisepsis, and brain localization laid the foundation for modern neurosurgery. Harvey Cushing pioneered neurosurgical specialization through his dedicated research on the surgical treatment of brain tumors and the understanding of intracranial pressure.[1]

The mid-20th century marked a pivotal turning point in neurosurgery. The discovery and application of X-rays enabled physicians to visualize intracranial structures for the first time without invasive procedures, revolutionizing diagnosis and treatment. Subsequent advancements in angiography further improved diagnostic precision for vascular pathologies. In the 1960s, Mahmut Gazi Yaşargil pioneered microneurosurgery, inventing microsurgical instruments, retractors, a floating microscope, and aneurysm clips. These innovations laid the foundation for the surgical principles and techniques of modern neurosurgery. By the late 20th century, the advent of computed tomography and magnetic resonance imaging transformed neurosurgical practice by providing high-resolution imaging for detailed preoperative planning and enhancing surgical efficacy. Intraoperative magnetic resonance imaging allows for surgeon orientation and visualization of spatial anatomy to address pathology and preserve vital structures.[2] In addition to imaging technologies, advancements in neurophysiological monitoring and other techniques have enabled highly precise neurosurgical procedures. These innovations have fostered neurosurgical subspecialization by requiring neurosurgeons to master niche techniques—from endoscopic skull base surgery to laser interstitial thermal therapy.

Concurrently, exponential growth in neuroscientific knowledge has reshaped traditional boundaries. The molecular characterization of gliomas, epigenetic profiling of meningiomas, and the rise of connectomics have necessitated domain-specific expertise. The 2021 World Health Organization Classification of Central Nervous System Tumors, which integrates genomic data into diagnostic criteria, epitomizes this shift.[3]

Subspecialization has profoundly elevated the standard of neurosurgical care. In vascular neurosurgery, microsurgical clipping and endovascular coiling now achieve aneurysm occlusion rates exceeding 95%, with morbidity plummeting to below 5%.[4] The use of robotic assistance in surgery has been linked to reduced operative times, less blood loss, and decreased radiation exposure for both patients and surgical teams.[5] Subspecialization has also galvanized translational research. Focused academic niches facilitate deeper collaborations with bioengineers, data scientists, and molecular biologists. The convergence of neurosurgeons specializing in functional disorders with artificial intelligence experts has led to the development of closed-loop deep brain stimulation systems capable of real-time seizure detection. In clinical practice, brain-computer interfaces are revolutionizing functional neurosurgery by enabling bidirectional communication between neural circuits and electronic devices. In pediatric neurosurgery, collaborations with developmental biologists are unraveling the ontogeny of Chiari malformations, informing earlier interventions. Establishing platforms that promote collaboration among neurosurgeons is crucial for the continued advancement of neurosurgery.

Despite its merits, subspecialization risks fragmenting neurosurgery into siloed factions. Numerous experts and neurosurgical societies have expressed concerns regarding excessive subspecialization within neurosurgery, maintaining a cautious stance toward subspecialty training and certification for neurosurgeons, but advocating that physicians improve their knowledge and skills in specific subspecialties.[6,7] Therefore, neurosurgical subspecialization is neither a transient trend nor an unalloyed virtue. We urge the community to pursue subspecialty growth while maintaining the comprehensive ethos that defines neurosurgery. This commitment is one of the core objectives behind launching this journal.

Furthermore, significant global disparities in neurosurgical care demand urgent attention, particularly in low- and middle-income countries. Limited resources in these regions result in delayed or inaccessible treatment for many patients. For instance, 85% of cerebrovascular disease-related deaths occur in low- and middle-income countries, and 70% of global epilepsy cases lack adequate treatment. Similar inequities exist in neuro-oncology, pediatric neurosurgery, and traumatic brain injury management. These disparities stem from systemic barriers, including insufficient infrastructure and limited access to subspecialty training for local neurosurgeons.[8] Through this journal, we aim to facilitate global knowledge exchange and provide learning opportunities for neurosurgeons worldwide.

Neurosurgical Subspecialties aims to serve as a platform for clinicians and scientists in neurosurgery worldwide, dedicated to

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publishing high-quality original research, cutting-edge reviews, opinions, commentaries, case reports, and letters across the neurosurgical subspecialties. We will collaborate with global neurosurgical experts to curate outstanding papers for each subspecialty, fostering interdisciplinary dialogue and driving innovation. We are thrilled to bring you the latest advances in neurosurgical subspecialties through this new journal!

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Conflict of interest

Both authors have served as editors-in-chief of *Neurosurgical Subspecialties* since July 2024. Apart from this, the authors have no other conflicts of interest to declare.

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Conceptualization and drafting manuscript (HYZ, WSP), review and critical editing (HYZ, WSP). Both authors have made significant contributions to the final manuscript and have approved it.

References

[1] Greenblatt SH. Harvey Cushing's paradigmatic contribution to neurosurgery and the evolution of his thoughts about specialization. Bull Hist Med 2003;77(4):789–822. doi:10.1353/bhm.2003.0168, PMID:14657584.

[2] Begley SL, McBriar JD, Pelcher I, Schulder M. Intraoperative MRI: A Review of Applications Across Neurosurgical Specialties. Neurosurgery 2024;95(3):527–536. doi:10.1227/neu.0000000000002933, PMID:38530004.

[3] Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, *et al*. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. Neuro Oncol 2021;23(8):1231–1251. doi:10.1093/neuonc/noab106, PMID:34185076.

[4] Belavadi R, Gudigopuram SVR, Raguthu CC, Gajjela H, Kela I, Kakarala CL, *et al*. Surgical Clipping Versus Endovascular Coiling in the Management of Intracranial Aneurysms. Cureus 2021;13(12):e20478. doi:10.7759/cureus.20478, PMID:35047297.

[5] Łajczak P, Żerdziński K, Jóźwik K, Laskowski M, Dymek M. Enhancing Precision and Safety in Spinal Surgery: A Comprehensive Review of Robotic Assistance Technologies. World Neurosurg 2024;191:109–116. doi:10.1016/j.wneu.2024.08.051, PMID:39151699.

[6] Couldwell WT, Rovit RL. Rethinking neurosurgical subspecialization. Surg Neurol 2002;58(6):359–370. doi:10.1016/s0090-3019(02)00903-5, PMID:12517596.

[7] Barrow DL. Subspecialization in neurosurgery. World Neurosurg 2013;80(5):e105–e106. doi:10.1016/j.wneu.2013.01.072, PMID:23333991.

[8] Asfaw ZK, Laeke T, Panigrahi M, Jayalakshmi S, Enam SA, Coelho G, *et al*. Closing the gaps: strategies to improve global neurosurgical subspecialty care. J Neurosurg 2025. doi:10.3171/2024.10.JNS241660, PMID:39889301.