



# Prominent Neurosurgery Books of the Western World: How They Defined the Era of Modern Neurosurgery in the 19<sup>th</sup> Century

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## ABSTRACT

The aim of this article is to introduce the 19<sup>th</sup> century neurosurgery books to reveal their contributions to modern neurosurgery. Methods In this study, 29 books were accessed, and reviewed, and the resources from the late 18<sup>th</sup> century and early 20<sup>th</sup> century were included. However, neurology or general surgery books that included neurosurgical subjects or chapter were excluded unless there were revolutionary ideas in their relevant chapters.

The books of this period observed to have some common differences from the books that were written in the previous century. Parallel to the concept of cerebral localization, which started to develop in this period, neurosurgery evolved from skull surgery to brain surgery.

Due to the advancements in patient care, anesthesia and sterile techniques, surgical medical branches showed rapid development in the 1800s. During this period, cerebral localization concept changed the comprehension and approach in neurosurgery and opened the gate of a new era in the field of neurological surgery unlike other branches and helped to establish modern neurosurgery. 19<sup>th</sup> century surgeons became able to operate on more complex cases with more advanced techniques. Knowledge of published pioneer papers and books help understanding of emergence of neurological surgery as a separate discipline.

**KEYWORDS:** Development of neurosurgery, History of neurosurgery, Neurosurgery book, 19<sup>th</sup> century

## INTRODUCTION

The 18<sup>th</sup> century is widely recognized as the age of enlightenment for neurosurgeons, while the 19<sup>th</sup> century is accepted as the pivotal era in the establishment of modern neurosurgery. Three major medical advancements in the 19<sup>th</sup> century transformed surgical practices and paved the way for the application of newer and modern techniques. The introduction of general anesthesia allowed patients to be operated on without pain and eliminated movement during the procedures. The understanding of infection sources through the concept of antisepsis allowed surgeries to be conducted using aseptic techniques. Postoperative care improved substantially, particularly in pain and infection control. During this period, some prominent surgeons specialized in head and

spine surgeries, primarily focusing on cases of craniospinal trauma. Apart from anesthesia and antisepsis, another lesser-known advancement that led to the modern neurosurgery was the development of cerebral localization (20). This enabled surgeons to develop techniques for treating intracranial maladies. Some of these surgeons documented their revolutionary ideas and practices through case reports and comments. The aim of this article is to introduce these authors' main works and shed light on their invaluable contributions to the evolution of modern neurosurgery.

## MATERIAL and METHODS

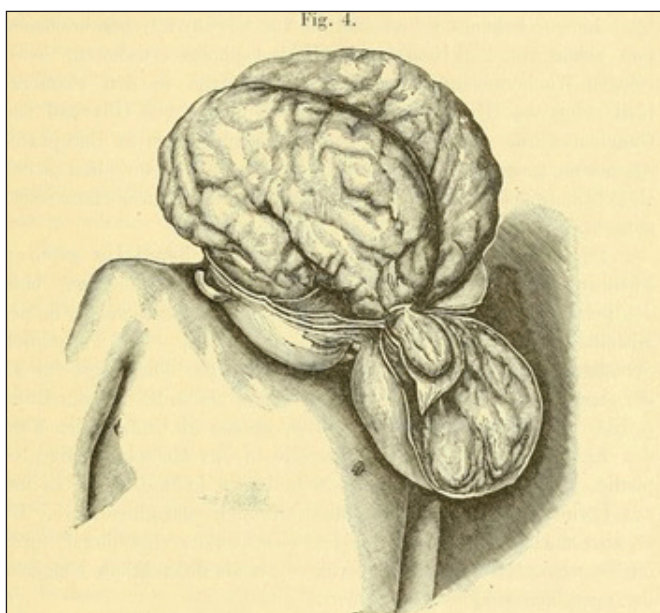
The prominent works of surgeons that changed the approach to craniospinal trauma were gathered through an extensive

review of various collections through online medical libraries (Table I). In this study, 29 books were accessed and reviewed, and resources from the late 18<sup>th</sup> century and early 20<sup>th</sup> century were also included, with a focus on maintaining the continuity of scientific progress. Neurology or general surgery books that included neurosurgical subjects or chapters were excluded unless they contained revolutionary ideas within those relevant chapters.

## ■ RESULTS

The books from this period exhibited some common differences from those written in the previous century, as outlined below:

- i. These books were influenced by studies of other disciplines, namely, neurology, which were authored during the same era.
- ii. Some of these books featured realistic and detailed drawings (Figure 1).
- iii. The detailed surgical techniques are explained in the chapters dedicated to neurosurgery.
- iv. In parallel with the concept of cerebral localization, these books described “safe” trepanation zones in the skull so that the brain could be protected from the impact.
- v. Various types of brain injuries, such as concussion, commotion, and contusion, were discussed.
- vi. The clarification of disease mechanisms gained more focus in these reports than in the descriptive case narratives of previous periods.



**Figure 1:** A figure from Bergmann’s book *Die chirurgische Behandlung von Hirnkrankheiten*. It depicts the ligation of the Encephalocystocele. Berlin: A. Hirschwald, 1899.

vii. Unlike the scientific norm of using Latin as a scientific language until the end of the 17<sup>th</sup> century, these books were written in the authors’ native languages.

viii. During this period, neurosurgery continued to be featured as a separate chapter in many surgical books, but dedicated neurosurgery books were also written.

Of these 29 books, 18 were in English, 7 were in German, and 4 were in French. Seventeen books addressed topics related to the nervous system or cranial surgery. The remaining were general surgical books, but included one or more chapters on neurosurgery. While many of the books focused on the surgical treatment of head trauma, and a few of them had sections and opinions on other aspects of neurosurgery, particularly, the surgical treatment of nerve injuries. These few books were written during the latter half of the 1800s. Some books had illustrations, either as simple technical drawings, or as elaborate, or rather artistic illustrations. These illustrations covered a wide range of subjects such as instruments, techniques, anatomy, and visual representations of diseases. The case narratives partially preserved their place in some books, but the more common approach in these works was to establish a general, reproducible knowledge through narrative and illustrative means.

## ■ DISCUSSION

Anatomically based studies in the field of neurologic sciences, which had their roots in the 17<sup>th</sup> century and continued to evolve throughout the 18<sup>th</sup> century, gradually evolved into functional studies in the 19<sup>th</sup> century. Surgeons of the 18<sup>th</sup> century developed thoughts about whether to trepane or not, made many arguments, and left many written works on this subject. One of the most striking ideas to emerge during the 18<sup>th</sup> century was the notion that the impact of trauma on the brain, not the skull, should be considered. These developments of the 17<sup>th</sup> and 18<sup>th</sup> centuries laid the foundation for what we now call “modern neurosurgery” in the 19<sup>th</sup> century.

The establishment of modern neurosurgery was not solely attributed to developments within the field, but was significantly influenced by three major medical advancements of the 19<sup>th</sup> century outside neurosurgery. The first of these improvements was anesthesia. With the introduction of anesthesia, surgeons gained the dual advantages of conducting painless surgeries and operating on immobile patients. The second major development during this period was antisepsis and aseptic technique. This progress prevented the loss of patients with severe infections postsurgery and facilitated wound care by preventing wound infection. The concept of “cerebral localization,” which was built on the knowledge of anatomy inherited from the previous century, was the most important change concerning neurosurgery, unlike other surgical branches.

Prior to the concept of “neurological localization,” locating brain lesions or injuries appeared futile to surgeons. In the second half of the 1800s, several researchers, most notably Paul Broca (1824– 1880), Eduard Hitzig (1838–1907), and Gustav Theodor Fritz (1838–1891), revealed that distinct functions

**Table I:** Some Prominent Neurosurgery Books Written in the 19<sup>th</sup> Century

Author	Book	Publishing year and publisher
John Jones	Plain concise practical remarks on the treatment of wounds and fractures	1776 Robert Bell
Benjamin Bell	A system of surgery	1785 Charles Eliot
Robert Mynors	A history of the practice of trepanning the skull, and the after-treatment: with observations upon a new method of cure: illustrated by a case.	1785 Piercy and Jones
Sylvester O'Halloran	A new treatise on the different disorders arising from external injuries of the head: illustrated by eighty-five (selected from about fifteen hundred) practical cases	1793 Zachariah Jackson
John Hunter	A treatise on the blood, inflammation, and gun-shot wounds	1794 John Richardson
Constant Saucerotte	Melange de chirurgie	1801
John Abernathy	Surgical observations on injuries of the head; and on miscellaneous subjects	1810 Longman
Charles Bell	Illustrations of the great operations of surgery, trepan, hernia, amputation, aneurism, and lithotomy	1821 Longman
John Abercrombie	Pathological and practical researches on diseases of the brain and the spinal cord	1829 Vaugh and Innes
Guillaume Dupuytren	Clinical lectures on surgery, delivered at the Hôtel-Dieu of Paris	1833 Boston, Carter, Hendee
Charles Bell	The nervous system of the human body	1836 Longman
William Sharp	Practical observations on injuries of the head	1841 John Churchill
Kajetan Von Textor	Grundzüge zur Lehre der chirurgischen Operationen	1835 Staherschen
Kajetan Von Textor	Ueber trepanation	1844 Friedrich Ernst Thein
Victor Bruns	Handbuch der praktischen Chirurgie für Artze und Wundartze	1854 Verlag Der H. Laupp
John E. Erichsen	The science and the art of surgery	1854 Branchard and Lea
S. Weir Mitchell and William	Gunshot wounds and other injuries of nerves	1864 Lippincott W. Keen
Samuel D. Gross	System of surgery	1866 Henry C. Lea
Eduard Albert	Beiträge zur Geschichte der Chirurgie	1871 Urban & Schwarzenberg
Lucas-Championniere	Étude historique et clinique sur la trépanation du crâne: la trépanation guidée par les localisations cérébrales	1878 V. A. Delahaye
Ernst von Bergmann	Lehre von den Kopfverletzungen	1880 Ferdinand Enke
John B Roberts	The field end limitations of the operative surgery of the human brain	1885 Blakiston
Antony A. Blowby	Injuries and diseases of the nerves and their surgical treatments	1890 P. Blakiston Son & Co.
Allen Starr	Brain surgery	1893 William Wood
William MacEwen	Pyogenic infective diseases of the brain and spinal cord: meningitis abscess of brain, infective sinus thrombosis	1893 James Macle hose
Antoine Chipault	Travaux de neurologie chirurgicale	1896 L. Battaille
William MacEwen	An introduction to the surgery of the head and neck	1898
Ernst von Bergmann	Die chirurgische Behandlung von Hirnkrankheiten	1899
Theodor Kocher	Chirurgische Operationslehre	1902 Gustav Fisher

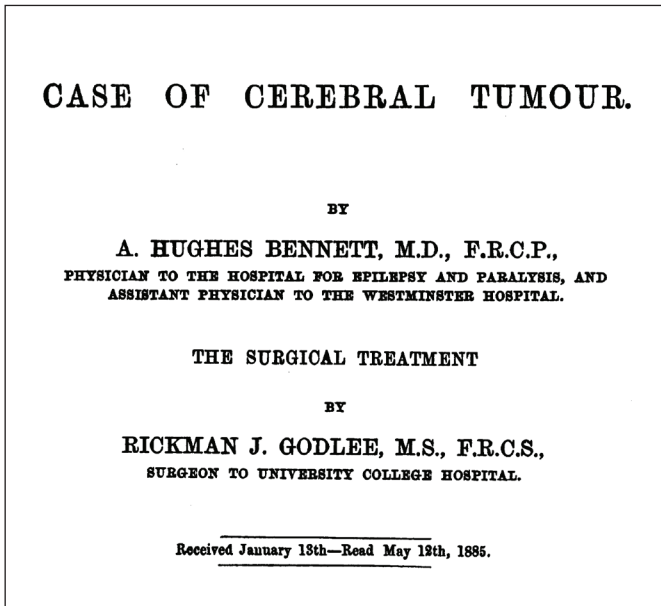
*The list of the books is arranged by chronological order.*

different brain regions (19,38). These studies gave impetus to studies for a better understanding of brain functions. David Ferrier (1842–1928), (24,34) and John Hughlings Jackson (1835–1911), (5,23,26) used electrical stimulation to establish the relationship between brain function and anatomy. These developments demonstrated the significance of neurological examinations in patient evaluation, gradually elaborated to determine the anatomy of the lesions and to understand their localization based on the observed impaired functions. Thus, surgeons began to make a surgical plan based on the lesion's location, shape, and length of the incision, as well as the shortest route to reach the desired area with minimal tissue damage. The first documented successful resection of a brain tumor was performed by the Scottish surgeon William Macewen (1848–1924) at the Glasgow Royal Infirmary on July 27, 1879. performed the first successful intracranial surgery, where the site of the lesion (a left frontal meningioma) was localized solely based on the preoperative focal epileptic signs (twitching of the face and arms in the opposite site of the lesion) (16,41). Rickmann Godlee (1849–1925) was the second to operate on a tumor determined by cerebral localization in 1885. Alexandre Bennet (1848–1901), a neurologist, has located the tumor (Figure 2). These were groundbreaking changes in neurosurgery (4,9).

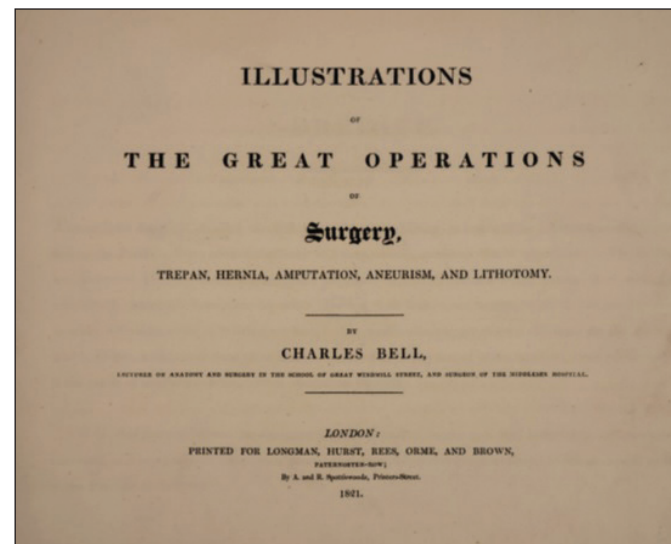
John Jones (1729–1791), in her 1776 book “Plain, Concise, Practical Remarks on the Treatment Of Wounds and Fractures,” devoted a chapter to the subject of commotio and concussion cerebri (27). Benjamin Bell (1849–1806) devoted the 26<sup>th</sup> chapter to head traumas in the third volume of his “A System of Surgery” which he wrote in 1785 and discussed contusions (6). At the beginning of this era, in 1793, Sylvester O'Halloran (1728–1807), dealt with all aspects of head trauma in his work “A new treatise on the different disorders arising from external injuries of the head: illustrated by eighty-five (selected from about fifteen hundred) practical cases,” which he exemplified with 85 cases, each with its own separate chapter dedicated to various types of trauma (32).

John Hunter (1728–1793), contributed to the field with his work dated 1974, titled “A treatise on the blood, inflammation, and gunshot wounds.” In this work, he discussed every aspect of gunshot wounds and showed the difference between normal injuries and damage to the brain resulting from gunshot injuries and damage (25). One of the earliest works addressing surgical hygiene as a topics was “Melanges de Chirurgie” of Constans Saucerotte. In this work, written in French in 1801, bleeding, cancer, and infections of the brain were also covered (35).

Charles Bell's (1774–1842) excellent, detailed and artistically illustrated work showed safe and unsuitable areas for trepanation. Bell wrote that the drawings were made with observations of surgery. He distinguished the motor and sensory components of spinal nerve roots and recommended the use of narcotics as analgesics to relieve postsurgical pain. In 1807, he formed a “System of comparative surgery,” in which surgery was considered almost entirely from an anatomical and operative perspectives, with minimal or no mention of the medicinal constituents. He went on to publish three books in 1821 and 1836 (Figure 3) (7,8).



**Figure 2:** Article “A case of cerebral tumor” by Bennet and Godlee in 1885. It is accepted that one of the developmental stages in neurosurgery.



**Figure 3:** Title page of Charles Bells' book “. Illustrations of the great operations of surgery, 1885 trepan, hernia, amputation, aneurism, and lithotomy”. London: Longman; 1821.

In 1829, John Abercrombie (1780–1844) authored a book titled “Pathological and Practical Researches on Diseases of the Brain and the Spinal Cord.” This work revealed the effects of inflammation on the brain's tissue and the surrounding membranes (1). On the other hand, John Abernathy (1764–1831) showed the trauma effects and drawings of the brain and its membranes, especially the venous structures, in her 1810 work “Surgical observations on injuries of the head; and on miscellaneous subjects” (2).

Guillaume Dupuytren, a versatile surgeon, who worked in every field of surgery, wrote two separate chapters on vertebral infections and vertebral dislocations in his book “Clinical Lectures on Surgery,” which he wrote in 1832 (17).

William Sharp (1805–1896) gave extensive information on brain compression and concussion in his book “Practical Observations on Injuries of the Head,” published in 1841. He presented his ideas and observations of the cause and nature of these conditions. Sharp advised against trepanation in patients with concussion because there was no extravasation of blood to eliminate, and the procedure would not put a stop to inflammation. He also suggested that the middle meningeal artery was the source of bleeding in epidural hematomas (36).

Kajetan Von Textor (1782–1860) devoted two chapters in a surgical book to trepanation and head traumas (39) and wrote a book in 1844 on the trepanation. He discussed the unnecessary use of trepanation in skull impressions (40). One of the most prolific surgeons, Victor Bruns (1812–1883), in his work called “Handbuch der praktischen Chirurgie,” dealt with the brain in regions and described surgical techniques topographically (13). This approach was a pioneering revelation in neurosurgery, as the book contained extensive information about treating possible accompanying conditions such as edema and inflammation. John Eric Erichsen (1818–1896) in his illustrated book “The Science and Art of Surgery,” written in 1854, devoted a section to head traumas. In this section, he discussed head trauma complications such as discharge of blood and serum coming from the ear and countercoup lesions (18).

William Keen (1837–1932), recognized as the first neurosurgeon of the United States (22), wrote a book in 1864 with Weir S. Mitchell, “Gunshot Wounds, and Other Injuries of Nerves” (28), as well as many of his publications on neurosurgery. The book was one of the first to address nerve damage and surgery. Another American surgeon, Samuel D. Gross (1805–1884), divided two chapters for head and nerve injuries in his “System of surgery,” which he wrote in 1866. These chapters provided detailed descriptions of both diagnostic and surgical techniques, accompanied by plenty of drawings (21).

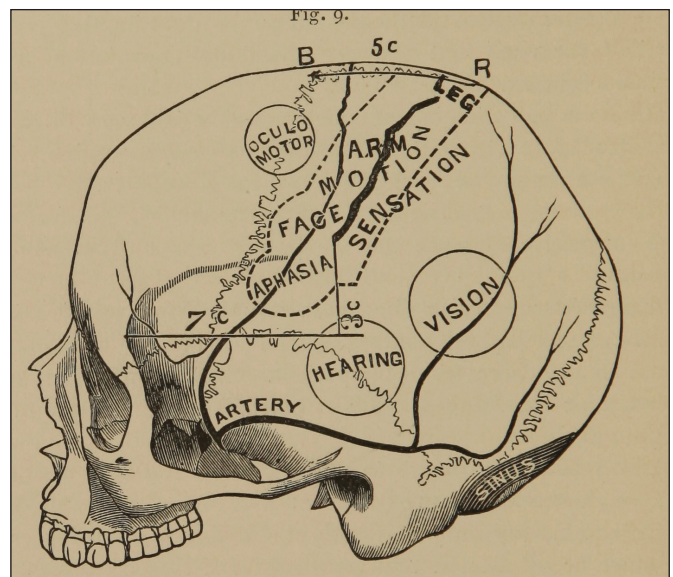
In German language, Eduard Albert (1841–1900) authored the book titled “Beitrage zur Geschichte der Chirurgie” in 1871. In this book, several large and detailed chapters were devoted to the brain and skull, and even the impact of patient position was discussed (3). Another German surgical work written from this period was “Die chirurgische Behandlung von Hirnkrankheiten.” In his book of 1899, Ernst Von Bergmann (1836–1907) described the surgical techniques according to the brain regions and suggested surgical treatments for specific infections such as tuberculosis, syphilis, actinomyces, as well as for diseases, such as microcephaly and congenital hydrocephalus that presented significant challenges at that time (11). In Bergmann’s other work, “Lehre von den Kopfverletzungen,” written in 1880, skull fractures were examined in detail and classified according to both their location and mechanism. He also wrote about his views and observations on contusions (10).

In 1885, John Bingham Roberts (1852–1924) for the first time authored the book “The Fields and Limitation of the Operative Surgery of the Human Brain,” which recommended craniotomy-based oncerebral localization. (Figure 4) (33).

In 1890, Antony Alfred Bowlby (1855–1929) wrote the book titled “Injuries and Diseases of Nerves and Their Surgical Treatment,” which featured excellent illustrations. In this work, he discussed nerve injuries separately based on their mechanisms and anatomical features. Bowlby provided surgical treatment recommendations for each case and examined the secondary conditions that could result from nerve damage (12).

Considered by some authors to be the founder of French Neurosurgery, Antoine Chipault (1866–1920), mentioned that in his book “Travaux de neurologie chirurgicale” that some of the thoughts were not his own. He quoted a lot from both old and contemporary works, such as Ambroise Paré and Allen Star. His book also contained original thoughts and observations (15), accompanied by numerous drawings. In addition, the interventions were described in great detail that we had not encountered before, and the measurements were in centimeters. Furthermore, the book published in 1896 covered spine surgeries including the procedures for the sacrum.

Another American surgeon, Allen Starr (1854–1932), wrote a book called “Brain Surgery” in 1893 (37). The book covered interventional treatments for trauma, microcephaly, hemor-



**Figure 4:** Diagram of the Exterior of the Skull indicated the measurement from JR’s book titled “The field and the limitations of the operative surgery of the human brain” for determining the position of the fissure of Rolando; and the location of the regions under which lie the centers of motion and sensation, as well as those of vision and hearing, and the oculo-motor centre. The position of the grooves for the two branches of the middle meningeal artery and for the lateral sinus is also shown. Philadelphia: Blakiston; 1885.

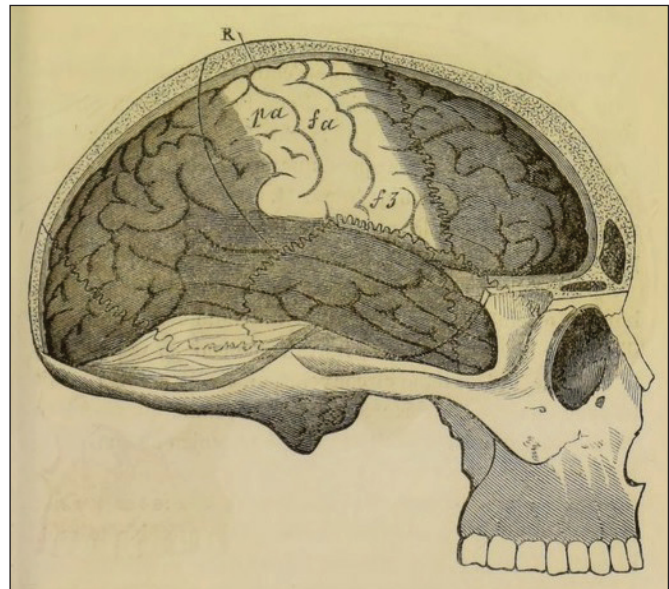
rhages, abscesses, tumor, hydrocephalus, and trepanation at elevated intracranial pressure (ICP), as well as procedures for mental retardation, insanity, and headache.

During this period, there were two books on trepanation that also dealt with the history of trepanation. Just-Marie-Marcellin Lucas-Championnière (1843–1913) published his book “Étude historique et clinique sur la trepanation du crâne: la trepanation guidée par les localisations cérébrales” in 1878 (Figure 5) (14). Lucas-Championnière emphasized the necessity of performing trepanation considering the location of the motor and sensory cortex, tracing the history of trepanations from ancient times. On the other hand, Robert Mynors (1739–1806) published his book “A history of the Practice of Trepanning the Skull, and the after treatment: with observations upon a new method of cure: illustrated by a case” in 1785 (31). He begins with an overview of Hippocrates contributions.

One of the most significant surgical figures of the 19th century was Emil Theodor Kocher (1841–1917). In the field of neurosurgery, his pioneering research covered areas such as concussion and ICP. Furthermore, he investigated the surgical treatment of epilepsy and spinal and cranial trauma. He found that in some cases, the epilepsy patients had a brain tumor that could be surgically removed, hypothesizing that epilepsy resulted from increased ICP and believed that drainage of cerebrospinal fluid could cure epilepsy. Kocher’s 1902 textbook, “Chirurgische Operationslehre,” dedicated 141 pages of its 1060 pages to nervous system surgery. It included methods of exploration and decompression of the brain (29,41). Harvey Cushing first detected the Cushing reflex in 1900 while working in his laboratory in Bern.

William Macewen (1848–1924) was another figure who contributed the most to neurosurgery in the 19th century. Succeeding the work of John Hughlings Jackson and David Ferrier on neurological localization of functions in the brain, Macewen demonstrated in 1876 that precise clinical examination could help to determine the possible site of a tumor or lesion in the brain, by observing its effects on the side and extension of alterations in motor and sensory functions (41). In 1893, he wrote a book on pyogenic infections of the brain and meninges, entitled “Pyogenic infective diseases of the brain and spinal cord: meningitis, abscess of brain, infective sinus thrombosis” (30). Surgical anatomy was given special attention in this book; thus, the book contained numerous illustrations.

Toward the end of the 19<sup>th</sup> century, neurosurgery had not yet emerged as a separate discipline. However, many surgeons focused on the nervous system and performed operations related to it. Surgeons in the 20<sup>th</sup> century were vastly different from the 19<sup>th</sup>-century surgeons in terms of understanding, approach, working style, and scientific thought. Notable figures among these 20<sup>th</sup>-century surgeons, who laid the foundation for “modern surgery” include Fedor Krause (1857–1937), Victor Horsley (1857–1916), Harvey Cushing (1869–1939), and Walter Dandy (1886–1946). These individuals built upon the treatises and studies of the eminent 19<sup>th</sup>-century surgeons mentioned here.



**Figure 5:** Figure describing the curved line passing through the parietal hump and dividing parietal into anterior and posterior from Championnière’s book entitled “Étude historique et clinique sur la trepanation du crâne: la trepanation guidée par les localisations cérébrales.” Paris: V. A. Delahaye; 1878.

### Limitations

It is important to acknowledge that the list of books presented in the article is likely to be incomplete. The books included in this list either contain original ideas or include pioneering applications in some technical subjects. Accessible and systematic books are mostly of western civilization origin. It is highly probable that similar manuscripts from the same era could be found from the communities such as China, India, Mesopotamia, and Japan. However, the accessibility of these contributions, if they exist, should be addressed by the scientific community to ensure public access.

### CONCLUSION

The 19<sup>th</sup> century witnessed significant advancements in patient care, anesthesia, and sterile techniques, leading to the rapid developments in surgical medical branches in the 1800s. During this period, the cerebral localization concept brought about a transformative shift in the comprehension and approach in the neurosurgery, unlike other branches, and helped to establish modern neurosurgery. In parallel with these developments, 19<sup>th</sup>-century surgeons gained the ability to operate on more complex cases using more advanced techniques. The surgeons mentioned in this article and the books they wrote led the field to a new era, modern neurosurgery. Publication of treatises and books demonstrated the success or failure of surgical decisions and techniques. A thorough understanding of these published pioneering papers and books is essential to understand the emergence of neurological surgery as a distinct discipline.

**AUTHORSHIP CONTRIBUTION**

Study conception and design: UE, SN

Data collection: UE, SN

Analysis and interpretation of results: UE

Draft manuscript preparation: UE

Critical revision of the article: UE, SN

Other (study supervision, fundings, materials, etc.): SN

All authors (UE, SN) reviewed the results and approved the final version of the manuscript.

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