



The Society of British Neurological Surgeons

100 Years in 100 Papers

*A history of discovery and clinical practice
through the scholarship of the neurosurgical community*



5 October 2026

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This collection celebrates the contribution of UK and Irish neurosurgery to research and clinical practice. The papers are grouped by subspecialty, with commentary describing their historical context and impact.

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Introduction

Research from around the world has had a fundamental role in establishing how we now practice our craft. Over the 100 years since establishment of the SBNS its members have made foundational and seminal contributions to the national and international science and practice of neurosurgery. This collection of papers provides a history of British neurosurgery as seen through a lens of scholarship.

British neurosurgeons have designed, led and contributed to a wide range of impactful research, not only randomised controlled trials, but also discovery and translational science and technical and surgical developments.

The impact of research manuscripts is not measured solely in citations. Few landmark works are conceived de novo, and the papers that document the incremental steps that underpin later research chart an important journey in ideas. Many of the axioms in neurosurgery that we take for granted have been hard won through quality research. If some of the findings reported in these papers at first appear mundane, they may be the key index reports, observations and interventions, from which you can see how much, and sometimes how little, progress has been made since.

Over the last 100 years there has been an evolution in academic neurosurgery practice from small research groups led by a single professor, to a team-science approach. This change is reflected in the published outputs, from single author publications (e.g., Donald Simpson, Australian neurosurgeon who analysed clinical data from Oxford and London to develop the Simpson grade of meningioma resection), to collaborative group models (e.g., the global COVID-19 surgery paper with 15,025 authors – a Guinness World Record). Within British neurosurgery collaborative research activity is led and supported from the ground up, by the British Neurosurgical Trainee Research Collaborative (BNTRC), and the Neurology and Neurosurgery Student Interest Group (NANSIG). Several important contributions are highlighted in this document.

This is just one history, built on the invited submissions from our SBNS community. There are other histories out there, and many more significant contributions on whose foundations we now stand. Our community's collective memory extends from the earliest days of the SBNS, but there will invariably be important omissions. These do not detract though from the highlighted successes. To those whose studies (their own or their nominations) are not included here, please continue to propose them. It's our intention, supported by the SBNS, to have a living history of British neurosurgery, and we will curate this narrative with other key papers brought to our attention.

The most important reason for this collection is to inform and inspire. Inform us all how varied the research methodologies have been in the studies that have been most impactful, how iterative the process is, and how we all can make a difference. We have presented the papers by subspecialty to show the evolution of academic work over the last 100 years and we hope you enjoy this selection!

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Functional neurosurgery

The scope of functional neurosurgery has evolved over the last 100 years from destructive, relatively imprecise procedures such as lobotomy and early lesioning, to highly targeted interventions guided by sophisticated neuroimaging, electrophysiology and neurophysiology. The development of stereotaxy, deep brain stimulation (DBS), intraoperative mapping and focused ultrasound has transformed treatment for disorders including Parkinson's disease, epilepsy, movement disorders and chronic pain, while increasingly enabling circuit-specific rather than tissue-destructive therapies. Some key UK contributions are detailed below.

In 1955 The Maudsley Neurosurgical Unit's series of 100 temporal lobectomy patients in the treatment of temporal lobe epilepsy were published in the *Lancet*. The long-term follow up was led by Murray Falconer [1] and subsequently by Charles Polkey [2], making major contributions that followed in the footsteps of Wilder Penfield in Montreal. The impact of surgery on preoperative personality change and psychosis was reported with an improvement in symptoms observed in over half the patients. At 2 years, 53% of patients were seizure free, 30% had a 'worthwhile' improvement, whilst 17% were unchanged). Four patients reported as being 'feeble-minded' did not improve after surgery – an early example of pre-operative patient selection to predict outcomes. A paper in 1991 developed this work further, with Elwes and Polkey reporting longer-term follow-up of 102 patients who had temporal lobe surgery for epilepsy. The probability of achieving seizure remission was 57% at one year, 70% at two years and 77% at seven years. The probability of remaining seizure free was 94% after two consecutive years of being seizure free. Outcomes at the end of year two are an excellent predictor of long-term control.

1. Falconer MA, Meyer A, Hill D, Mitchell W, Pond DA. Treatment of temporal-lobe epilepsy by temporal lobectomy; a survey of findings and results. *Lancet*. 1955 Apr 23;268(6869):827-35. doi: [10.1016/s0140-6736\(55\)90421-9](https://doi.org/10.1016/s0140-6736(55)90421-9). PMID: 14368879.
2. Elwes RD, Dunn G, Binnie CD, Polkey CE. Outcome following resective surgery for temporal lobe epilepsy: a prospective follow up study of 102 consecutive cases. *J Neurol Neurosurg Psychiatry*. 1991 Nov;54(11):949-52. doi: [10.1136/jnnp.54.11.949](https://doi.org/10.1136/jnnp.54.11.949). PMID: 1800664; PMCID: PMC1014613.

In 1960, Gillingham published a five year study of the effects of discrete lesions of the globus pallidus, thalamus and internal capsule for the relief of parkinsonism. This paper on Small Localised Surgical Lesions of the Internal Capsule in the Treatment of the Dyskinesias describes Gillingham's pioneering work on stereotaxy in Edinburgh.

3. F.J. Gillingham; Small Localised Surgical Lesions of the Internal Capsule in the Treatment of the Dyskinesias. *Confinia Neurologica* 31 December 1962; 22 (3-5): 385–392. <https://doi.org/10.1159/000104390>

In 1991, Tipu Aziz's landmark study in Oxford, showed that overactivity of the subthalamic nucleus was central to the neural mechanism of MPTP-induced parkinsonism. Lesioning the subthalamic nucleus in two primates with this condition produced a remarkable amelioration of the disorder. Aziz's work in primates then contributed to Alim-Louis Benabid in France to use the STN as a new target for DBS for Parkinson's, a procedure that has been taken up worldwide.

4. Aziz TZ, Peggs D, Sambrook MA, Crossman AR. Lesion of the subthalamic nucleus for the alleviation of 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced parkinsonism in the primate. *Mov Disord*. 1991;6(4):288-92. doi: [10.1002/mds.870060404](https://doi.org/10.1002/mds.870060404). PMID: 1758446.

In 2010, Williams and the PD SURG Collab Group reported the largest Randomised Controlled Trial in Functional Neurosurgery. The multi-centre study design set the stage for the development of Deep Brain Stimulation in many UK neurosurgical units. Ultimately, the results led to the NHS funding DBS in Parkinson's Disease.

5. Williams A, Gill S, Varma T, Jenkinson C, Quinn N, Mitchell R, Scott R, Ives N, Rick C, Daniels J, Patel S, Wheatley K; PD SURG Collaborative Group. Deep brain stimulation plus best medical therapy versus best medical therapy alone for advanced Parkinson's disease (PD SURG trial): a randomised, open-label trial. *Lancet Neurol.* 2010 Jun;9(6):581-91. doi: [10.1016/S1474-4422\(10\)70093-4](https://doi.org/10.1016/S1474-4422(10)70093-4). Epub 2010 Apr 29. PMID: 20434403; PMCID: PMC2874872..

Glial cell line-derived neurotrophic factor (GDNF) is a potent neurotrophic factor with restorative effects in a wide variety of rodent and primate models of Parkinson disease, but penetration into brain tissue from either blood or cerebrospinal fluid is limited. In 2003, the pioneering Bristol neuroscience team led by neurosurgeons Steve Gill and P Heywood delivered the first large-scale clinical trial to directly administer GDNF into the brain for Parkinson's disease. The promising early results were published in *Nature Medicine* (>1500 citations) and a BBC documentary was broadcast.

6. Gill SS, Patel NK, Hotton GR, O'Sullivan K, McCarter R, Bunnage M, Brooks DJ, Svendsen CN, Heywood P. Direct brain infusion of glial cell line-derived neurotrophic factor in Parkinson disease. *Nat Med.* 2003 May;9(5):589-95. doi: [10.1038/nm850](https://doi.org/10.1038/nm850). Epub 2003 Mar 31. PMID: 12669033.

After the pilot study of direct GDNF delivery into the brain, the Bristol team of Whone and Gill conducted a randomized trial in Parkinson's disease using convection-enhanced delivery (CED) to administer GDNF to the putamen via a skull-mounted port. This was a novel approach to treatment for neurodegenerative diseases. Although this study did not prove clinical benefit at 40 weeks, 18F-DOPA imaging suggested that intermittent CED of GDNF produced a putamen-wide tissue engagement effect, overcoming prior delivery limitations. This study, published in *Brain*, provided key learning on patient selection, drug dose, delivery duration, and potential confounders with placebo effect. This study marked a potential paradigm shift in direct-target delivery of novel therapies, applicable to a host of neurological conditions.

7. Whone A, Luz M, Boca M, Woolley M, Mooney L, Dharia S, Broadfoot J, Cronin D, Schroers C, Barua NU, Longpre L, Barclay CL, Boiko C, Johnson GA, Fibiger HC, Harrison R, Lewis O, Pritchard G, Howell M, Irving C, Johnson D, Kinch S, Marshall C, Lawrence AD, Blinder S, Sossi V, Stoessl AJ, Skinner P, Mohr E, Gill SS. Randomized trial of intermittent intraputamenal glial cell line-derived neurotrophic factor in Parkinson's disease. *Brain.* 2019 Mar 1;142(3):512-525. doi: [10.1093/brain/awz023](https://doi.org/10.1093/brain/awz023). PMID: 30808022; PMCID: PMC6391602.

Bilateral anterior cingulotomy can be used palliatively for cancer pain. Pereira and colleagues described a case of debilitating thoracic wall pain due to malignant mesothelioma, which was relieved by bilateral anterior cingulotomy. The patient's dyspnoea improved. The findings elucidated the role of the anterior cingulate cortex in pain and autonomic control of respiration. Quality of life improvements were seen for 2 months after surgery, and pain relief was sustained to death.

8. Pereira EA, Paranathala M, Hyam JA, Green AL, Aziz TZ. Anterior cingulotomy improves malignant mesothelioma pain and dyspnoea. *Br J Neurosurg.* 2014 Aug;28(4):471-4. doi: [10.3109/02688697.2013.857006](https://doi.org/10.3109/02688697.2013.857006). Epub 2013 Nov 7. PMID: 24199940.

In 2021 a study by P Ghimire and K Ashkan proposed a supplemental clinical cortical map, and a novel subcortical motor map, to improve on Wilder Penfield's original motor homunculus. This included demonstrating the localization of intercostal muscles both in the cortex and subcortex, which had not been previously described. The maps of the homunculus were derived from a large cohort of patients undergoing

direct cortical and subcortical brain mapping. The information is relevant for improving patient safety and outcomes with resection of motor eloquent brain lesions.

9. Ghimire P, Lavrador JP, Baig Mirza A, Pereira N, Keeble H, Borri M, Furlanetti L, Brogna C, Jarosz J, Gullan R, Vergani F, Bhangoo R, Ashkan K. Intraoperative mapping of pre-central motor cortex and subcortex: a proposal for supplemental cortical and novel subcortical maps to Penfield's motor homunculus. *Brain Struct Funct.* 2021 Jun;226(5):1601-1611. doi: [10.1007/s00429-021-02274-z](https://doi.org/10.1007/s00429-021-02274-z). Epub 2021 Apr 19. PMID: 33871691; PMCID: PMC8096772.

Oncology

The British neurosurgical neuro-oncology community are today making major contributions to discovery and clinical sciences, pioneering precision therapy platforms, liquid biopsies for brain tumour detection, novel implantable technologies and gene therapies, amongst other endeavours. There is a long history of such major contributions. The first ever documented glioma surgery was performed in 1884 by general surgeon Sir Rickman Godlee, (nephew of Joseph Lister), years before neurosurgery was conceived as a specialty. The patient was a 25-year-old farm labourer with Jacksonian epilepsy. The lesion was localised by a neurologist and the operation took place at The Hospital for Epilepsy and Paralysis in London. The surgery involved trephining the bone and removing the glioma. The patient's epilepsy and hemiparesis improved but he died on the 28th post-operative day from wound infection and meningitis. Godlee was vilified in the press and accused of human vivisection. He never practiced neurosurgery again, but was later visited by both Victor Horsley and Harvey Cushing, who took up the challenge of neurosurgery.

Almost a century after that glioma surgery, Sikora and colleagues observed that surgery, radiotherapy and chemotherapy were having little impact on outcomes for patients with poorly differentiated gliomas. Their work was the first to explore production of human glioma specific antibodies after fusion of glioma lymphocytes and mouse myeloma cells. Along with neurosurgeon Jack Phillips, they made hybridomas with human tissue. Lymphocytes from within the glioma were producing antibodies that bound to glioma cells. This paved the way for the burgeoning interest in harnessing the immune system against a patient's own tumour.

10. Production and localisation of the first Human Monoclonal to Malignant Brain Tumours. Sikora K, Alderson T, Phillips J, Watson JV. Human hybridomas from malignant gliomas. *Lancet*. 1982 Jan 2;1(8262):11-4. doi: [10.1016/s0140-6736\(82\)92556-9](https://doi.org/10.1016/s0140-6736(82)92556-9). PMID: 6119412.

The modern image guided surgery that we now take largely for granted, was pioneered by David Thomas (Queen Square), SBNS secretary and later an Honorary President of the WFNS, along with Patrick Kelly (Mayo/ New York). Thomas was the first to use MRI for brainstem biopsy in this landmark study. In the 1980's there was little interest in this subject in the UK, but recognition came internationally.

11. Thomas, D. G. T., Bradford, R., Gill, S., & Davis, C. H. (1988). Computer-directed Stereotactic Biopsy of Intrinsic Brain Stem Lesions. *British Journal of Neurosurgery*, 2(2), 235–240. <https://doi.org/10.3109/02688698808992674>

In another first, Garth Cruikshank and colleagues in 1994 made a pioneering contribution to our understanding of tumour biology by making direct measurements of intra-tumoural oxygen levels from within the tumour microenvironment, using microelectrodes. The aim was to assess whether malignant brain tumours might benefit from targeting with bio-reductive drugs (tirapazamine and nitroimidazoles). 20 patients were assessed, with 6 insertion tracks per patient. The study demonstrated that In glioblastoma there was a significant hypoxic component of tissue, with less marked hypoxia in astrocytoma and brain metastases.

12. Rampling R, Cruickshank G, Lewis AD, Fitzsimmons SA, Workman P. Direct measurement of pO₂ distribution and bioreductive enzymes in human malignant brain tumors. *Int J Radiat Oncol Biol Phys*. 1994 Jun 15;29(3):427-31. doi: [10.1016/0360-3016\(94\)90432-4](https://doi.org/10.1016/0360-3016(94)90432-4). PMID: 8005794.

The outcomes for patients with glioblastoma have changed little in the last two decades, but our understanding of the tumour's key molecular features has evolved. Published in the *Lancet* in 2003, Hakin-Smith and colleagues reported a study of telomeres in 77 patients having cranial surgery in Sheffield. This was amongst

first to identify the impact of telomere length on long-term survival for patients with glioblastoma, and contributed to the 2021 WHO molecular classification update.

13. Hakin-Smith V, Jellinek DA, Levy D, Carroll T, Teo M, Timperley WR, McKay MJ, Reddel RR, Royds JA. Alternative lengthening of telomeres and survival in patients with glioblastoma multiforme. *Lancet*. 2003 Mar 8;361(9360):836-8. doi: [10.1016/s0140-6736\(03\)12681-5](https://doi.org/10.1016/s0140-6736(03)12681-5). PMID: 12642053.

In 2015, an England-wide series demonstrated outcomes for patients with a Glioblastoma over a 5 year period. The age and treatment related data has helped inform patient discussion and treatment decision-making, and demonstrates the real impact of this disease, rather than the best outcomes in highly selected groups reported as part of trial or cohort studies. Such real-world data is invaluable to support more accurate clinical trial design.

14. Brodbelt A, Greenberg D, Winters T, Williams M, Vernon S, Collins VP; (UK) National Cancer Information Network Brain Tumour Group. Glioblastoma in England: 2007-2011. *Eur J Cancer*. 2015 Mar;51(4):533-542. doi: [10.1016/j.ejca.2014.12.014](https://doi.org/10.1016/j.ejca.2014.12.014). Epub 2015 Feb 3. PMID: 25661102.

Alongside molecular characterisation and epidemiological studies, the SBNS community has made seminal contributions to novel therapies and diagnostics. In 2023, a multi-centre phase 3 trial of Autologous Tumor Lysate-Loaded Dendritic Cell Vaccination, with a leading contribution from the UK (Ashkan), was the first to suggest significant survival benefit for patients with newly diagnosed or recurrent GBM. The study confirmed the opportunity for immunotherapy as a treatment modality.

15. Liao LM, Ashkan K, Brem S, Campian JL, et al. Association of Autologous Tumor Lysate-Loaded Dendritic Cell Vaccination With Extension of Survival Among Patients With Newly Diagnosed and Recurrent Glioblastoma: A Phase 3 Prospective Externally Controlled Cohort Trial. *JAMA Oncol*. 2023 Jan 1;9(1):112-121. doi: [10.1001/jamaoncol.2022.5370](https://doi.org/10.1001/jamaoncol.2022.5370). PMID: 36394838; PMCID: PMC9673026.

In another UK-neurosurgeon-delivered world first, in 2026 Brennan and colleagues reported an international multicentre clinical trial of a liquid biopsy for identification of symptomatic patients at high risk of a brain tumour. Based on a platform infra-red spectroscopy technology, and machine learning, this heralded a transformative step in diagnosis of symptomatic patients.

16. Brennan PM, Cameron JM, Eustace D, Butler HJ, et al. A multi-centre performance evaluation of a commercially developed liquid biopsy for the earlier detection of brain tumours. *ESMO Open*. 2026 Jan;11(1):105938. doi: [10.1016/j.esmoop.2025.105938](https://doi.org/10.1016/j.esmoop.2025.105938). Epub 2025 Dec 29. PMID: 41468686; PMCID: PMC12804056.

The UK are also leaders in clinical sciences targeting improving treatment for patients living with meningiomas. For example, from a study of 441 patients with incidental meningiomas, a prognostic model was developed to personalize monitoring regimes for patients with incidental asymptomatic meningiomas. The model combines imaging and clinical factors to predict the risk of growth and treatment intervention by 5 years after diagnosis. Patients were stratified into low-, medium- and high-risk groups and 5-year disease progression rates were 3%, 28%, and 75%, respectively. After 5 years of follow-up, the risk of disease progression plateaued in all groups. This provides a useful tool to manage patients in clinical practice that has been further validated in a BNTRC-led international cohort study, which demonstrated the generalisability of the tool to other healthcare settings.

17. Islim AI, Kolamunnage-Dona R, Mohan M, Moon RDC, et al. A prognostic model to personalize monitoring regimes for patients with incidental asymptomatic meningiomas. *Neuro Oncol*. 2020 Feb 20;22(2):278-289. doi: [10.1093/neuonc/noz160](https://doi.org/10.1093/neuonc/noz160). PMID: 31603516; PMCID: PMC7032634.

18. Islim AI, Millward CP, Zakaria R, Piper RJ, et al; IMPACT Study Investigators, International Consortium on Meningioma (ICOM) and British Neurosurgical Trainee Research Collaborative (BNTRC). A Clinical Tool to Identify Incidental Meningioma for Early Outpatient Management. *JAMA Oncol.* 2026 Jan 1;12(1):66-74. doi: [10.1001/jamaoncol.2025.4821](https://doi.org/10.1001/jamaoncol.2025.4821). PMID: 41264316; PMCID: PMC12635927.

Should patients who have had complete surgical resection of a grade 2 atypical meningioma have adjuvant radiotherapy? This was the research question addressed by Jenkinson and colleagues in the UK-led phase 3 randomised controlled trial in WHO grade 2 atypical meningioma. The study was conceived in 2011 in response to a change in the WHO classification that led to an increase in diagnosis of atypical meningiomas from 5% to 20-25% of all meningiomas. There was no consensus on whether patients should also be offered post-operative radiotherapy. The study was led by the UK as an intergroup collaboration with the EORTC (58 hospitals in 11 countries) to determine whether adjuvant fractionated radiotherapy reduced the risk of recurrence in patients who had undergone complete resection of a grade 2 atypical meningioma. Compared to observation, adjuvant fractionated radiotherapy halved the risk of recurrence without affecting health-related quality of life and with minimal radiation-toxicity. This trial is practice-changing and will inform national and international guidelines.

19. Jenkinson MD, Rosala-Hallas A, Sahm F, Andratschke N, et al; ROAM/1308 Study Collaborators. Radiotherapy versus observation following surgical resection of WHO grade 2 atypical meningioma (ROAM/EORTC-1308): an international, multicentre, open-label, phase 3, randomised controlled trial. *Lancet.* 2026 Sep 25:S0140-6736(26)01804-0. doi: [10.1016/S0140-6736\(26\)01804-0](https://doi.org/10.1016/S0140-6736(26)01804-0). Epub ahead of print. PMID: 42790456.

Spine

Over the past 100 years, spinal surgery has evolved greatly, supported by advances in imaging, navigation and instrumentation, as well as anaesthesia and perioperative care. Major developments in spinal instrumentation, fusion and minimally invasive techniques have transformed trauma, deformity and degenerative disease management, while innovations in spinal monitoring and microsurgical techniques also underpin improved outcomes for patients with intrinsic diseases. To navigate the myriad treatment options, evidence-based approaches to patient selection are key, and critically may recommend non-surgical approaches to management of spinal pathologies.

In 1919, Jefferson reported four cases of fracture of the atlas vertebra, with a review of previously reported cases. He provided discussion of mechanisms underlying fracture of C1, and dispelled the perception that it was invariably fatal.

- 20.** Jefferson, G. (1919), Fracture of the atlas vertebra. Report of four cases, and a review of those previously recorded. *Br J Surg*, 7: 407-422. <https://doi.org/10.1002/bjs.1800072713>

John O'Connell, a former SBNS President, was a most meticulous neurosurgeon. He reported a clinical review of five hundred cases of lumbar intervertebral disc protrusions treated by discectomy, without myelogram, CT, or microscope. His results, during wartime at Hill End Hospital and Barts set a gold standard for lumbar discectomy, with 92% of patients returning to work, free from sciatica or substantially improved. The recurrence rate was only 2%.

- 21.** O'CONNELL JE. Protrusions of the lumbar intervertebral discs, a clinical review based on five hundred cases treated by excision of the protrusion. *J Bone Joint Surg Br*. 1951 Feb;33-B(1):8-30. doi: [10.1302/0301-620X.33B1.8](https://doi.org/10.1302/0301-620X.33B1.8). PMID: 14814156.

Probably the first description of the successful surgical management of thoracic discs with recovery of function was by Logue in 1952, describing 11 cases and highlighting the surgical approach and pitfalls. Six patients had good outcome with recovery of neurological function, but five patients, all severely disabled before surgery, did not improve.

- 22.** Thoracic intervertebral disc prolapse with spinal cord compression. *J Neurol Neurosurg Psychiatry*. 1952 Nov;15(4):227-41. doi: [10.1136/jnnp.15.4.227](https://doi.org/10.1136/jnnp.15.4.227). PMID: 13011651; PMCID: PMC499566.

After the disappointing results for thoracic disc removal reported previously, George Alexander and Allan Hulme adopted a pioneering lateral surgical approach to thoracic disc protrusions (extension of costotransversectomy). This large case series reported the good clinical results that they achieved, and this technique is still in use today.

- 23.** Hulme A. The surgical approach to thoracic intervertebral disc protrusions. *J Neurol Neurosurg Psychiatry*. 1960 May;23(2):133-7. doi: [10.1136/jnnp.23.2.133](https://doi.org/10.1136/jnnp.23.2.133). PMID: 14403949; PMCID: PMC495343.

With neurosurgeons Polkey & Teddy, the physiologist Giles Brindley pioneered implantation of electrical stimulators for bladder control. Eleven patients underwent sacral nerve stimulator implantation, allowing them to all successfully empty their bladder and regain continence.

- 24.** Brindley GS, Polkey CE, Rushton DN. Sacral anterior root stimulators for bladder control in paraplegia. *Paraplegia*. 1982 Dec;20(6):365-81. doi: [10.1038/sc.1982.65](https://doi.org/10.1038/sc.1982.65). PMID: 6984503.

As a slight aside in this spinal research section, Brindley and Lewis followed the bladder study with implantation in a blind patient of radio receivers connected to electrodes in contact with the occipital pole of the right cerebral hemisphere. By giving appropriate radio signals the patient could be caused to experience sensations of light ('phosphenes') in the left half of the visual field. By stimulation through several electrodes simultaneously the patient could be caused to see predictable simple patterns, a prototype for a useful prosthesis.

25. Brindley GS, Lewin WS. The sensations produced by electrical stimulation of the visual cortex. *J Physiol.* 1968 May;196(2):479-93. doi: [10.1113/jphysiol.1968.sp008519](https://doi.org/10.1113/jphysiol.1968.sp008519). PMID: 4871047; PMCID: PMC1351724.

First introduced by Huw Griffith and colleagues in 1985, day-case lumbar microdiscectomy was a pioneering approach at a time when these procedures typically involved much longer hospital stays. This 1994 paper demonstrated the feasibility and safety of performing day-case microdiscectomies, with low complication rates and high patient satisfaction. Despite its initial limited adoption, this innovative framework laid the foundation for growing acceptance and more widespread implementation.

26. Kelly A, Griffith H, Jamjoom A. Results of day-case surgery for lumbar disc prolapse. *Br J Neurosurg.* 1994;8(1):47-9. doi: [10.3109/02688699409002392](https://doi.org/10.3109/02688699409002392). PMID: 8011193.

Transoral approaches were developed to gain ventral access to structures from the sphenoid sinus rostrally, to the fourth cervical vertebra caudally. Crockard's 1985 paper established the transoral approach to permit decompression of the brainstem and upper cervical cord. He demonstrated that the technique could be applied to a range of pathologies, with microsurgical techniques and watertight dural closure extending its potential indications. The paper lay groundwork for subsequent development of anterior skull-base and craniovertebral junction surgery.

27. Crockard HA. The transoral approach to the base of the brain and upper cervical cord. *Ann R Coll Surg Engl.* 1985 Sep;67(5):321-5. PMID: [3901865](https://pubmed.ncbi.nlm.nih.gov/3901865/); PMCID: PMC2499532.

In patients requiring spinal fusion, the potential for adjacent segment disease is of particular concern. In this 2002 study Wigfield and colleagues considered the potential benefit of preserving and mimicking physiological motion through cervical intervertebral disc replacement in degenerative cervical spine disease. As the debate on disc replacement versus fusion continues on a global scale today, this seminal paper is one of the first to provide a biomechanical basis for these treatment strategies.

28. Wigfield C, Gill S, Nelson R, Langdon I, Metcalf N, Robertson J. Influence of an artificial cervical joint compared with fusion on adjacent-level motion in the treatment of degenerative cervical disc disease. *J Neurosurg.* 2002 Jan;96(1 Suppl):17-21. doi: [10.3171/spi.2002.96.1.0017](https://doi.org/10.3171/spi.2002.96.1.0017). PMID: 11795709.

Most patients with sciatica caused by a disc prolapse will get better without surgery. This seminal randomised controlled trial by Wilby and colleagues compared nerve root injection to lumbar discectomy in patients with new onset symptoms of sciatica. It demonstrated that root injection provided a similar level of efficacy to surgery and was more cost effective. For patients with sciatica secondary to herniated lumbar disc, with symptom duration of up to 12 months, root injection should be considered as a first invasive treatment option.

29. Wilby MJ, Best A, Wood E, Burnside G, et al. Surgical microdiscectomy versus transforaminal epidural steroid injection in patients with sciatica secondary to herniated lumbar disc (NERVES): a phase 3, multicentre, open-label, randomised controlled trial and economic evaluation. *Lancet Rheumatol.* 2021 Mar 18;3(5):e347-e356. doi: [10.1016/S2665-9913\(21\)00036-9](https://doi.org/10.1016/S2665-9913(21)00036-9). PMID: 33969319; PMCID: PMC8080892.

Cauda equina syndrome (CES) has the potential to ruin lives as well as the bladder, bowel, and sexual functions, and costs millions in medicolegal claims. However, until this 2022 paper from Woodfield and colleagues, studies were small and often contradictory. This led to a nihilism about patients who presented with symptoms of complete retention. Woodfield's study included 621 patients from more than 30 centres, and was the largest prospective cohort of patients with CES. Post-operative functional improvement occurred even in those presenting with urinary retention and there was no association between outcomes and time to surgery. Services can be planned based on the data, and patients get better prognostic information. It was part of a body of work which investigated country wide prevalence of CES, definitions of CES and inter-rater reliability of CES subclassifications.

- 30.** Woodfield J, Hoeritzauer I, Jamjoom AAB, Jung J, et al; UCES Collaborators; British Neurosurgical Trainee Research Collaborative. Presentation, management, and outcomes of cauda equina syndrome up to one year after surgery, using clinician and participant reporting: A multi-centre prospective cohort study. *Lancet Reg Health Eur.* 2022 Nov 17;24:100545. doi: [10.1016/j.lanepe.2022.100545](https://doi.org/10.1016/j.lanepe.2022.100545). PMID: 36426378; PMCID: PMC9678980.

The Duration of External Neck Stabilization (DENS) study randomised older or frail patients with a new odontoid fracture to collar or no collar, because cervical hard collars are harmful in this population. The study ran during the COVID19 pandemic and under recruited, but the lack of benefit from a collar in quality of life metrics was nevertheless important. Clinicians should consider prioritising independence and comfort of older/frail patients with odontoid fracture by early collar removal. This study supports that this can be achieved without a clear detriment to the patient.

- 31.** Brennan PM, Adamczyk M, Closs M, Copley P, et al. Duration of external neck stabilisation in the management of older and frail patients with a new odontoid fracture: the DENS RCT. *Health Technol Assess.* 2026 May;30(62):1-36. doi: [10.3310/GJPB0728](https://doi.org/10.3310/GJPB0728). PMID: 42104907; PMCID: PMC13181504.

Paediatrics

Over the past century, paediatric neurosurgery has progressed from high-risk open procedures to increasingly precise and personalised care. CSF shunts transformed hydrocephalus management and patient outcomes, and innovations in CSF management continue. The 21st century has brought fetal surgery, enhanced minimally invasive techniques, and robotics, and where paediatric neurosurgeons lead on transformations to neurosurgical care, adult practices usually follow.

John O'Connell, from St Bartholomew's, London, was amongst the pioneers of surgical separation of craniopagus twins, 50 years earlier than most people. Three years after his retirement he published this remarkable paper of three sets of patients, with exquisite illustrations. Remarkably, this high-risk, high-reward surgery predates even CT imaging.

32. O'Connell JE. Craniopagus twins: surgical anatomy and embryology and their implications. *J Neurol Neurosurg Psychiatry*. 1976 Jan;39(1):1-22. doi: [10.1136/jnnp.39.1.1](https://doi.org/10.1136/jnnp.39.1.1). PMID: 1255206; PMCID: PMC492208.

In 2003, the DRIFT (DRainage Irrigation and Fibrinolytic Therapy) trial, based in Bristol's St Michael's Hospital, reported data from a study aiming to wash out intraventricular blood and cytokines in infants with post-haemorrhagic ventricular dilatation (PHVD). Though the randomised controlled trial did not show reduction in mortality and shunt surgery, both at 2-year and 10-year follow up, the DRIFT arm showed sustained reduction in severe cognitive impairment, thereby demonstrating the efficacy of neuro-endoscopic lavage in the treatment of PHVD. This study provided evidence that underpins the ongoing NIHR-funded ENLIVEN-UK trial (GOSH)

33. Luyt K, Jary SL, Lea CL, Young GJ, et al, Hollingworth W, Morgan M, Smith-Collins AP, Walker-Cox S, Aquilina K, Pople I, Whitelaw AG. Drainage, irrigation and fibrinolytic therapy (DRIFT) for posthaemorrhagic ventricular dilatation: 10-year follow-up of a randomised controlled trial. *Arch Dis Child Fetal Neonatal Ed*. 2020 Sep;105(5):466-473. doi: [10.1136/archdischild-2019-318231](https://doi.org/10.1136/archdischild-2019-318231). Epub 2020 Jul 4. PMID: 32623370; PMCID: PMC7547901.

Trauma

Improving outcomes for patients with traumatic brain injury has been a major focus of research for neurosurgeons internationally over the last 100 years, and British neurosurgeons have played a central role in this work. Wartime efforts underpinned much of the early pioneering work. The introduction of CT scanning later enabled rapid, accurate diagnosis of intracranial pathology, then Intracranial pressure monitoring became standard, evolving into multimodality neuromonitoring. Management pathways, treatment guidelines and advances in neurocritical care all contributed to enhancing outcomes, shifting focus from mere survival to functional recovery.

In 1941, the case for crash helmets to reduce injuries in motorcyclists was made by Hugh Cairns in this landmark paper. Data from 149 patients with fatal motor cycling injuries who had not worn helmets was reported. In a series of patients with nonfatal injuries he then studied the effect of the helmet. His purpose was stated as to advocate for the routine wearing of head protection to reduce the risk of injury. The proposed helmet consisted of a firm outer shell, and an inner sling that sat against the head.

34. Cairns H. Head Injuries in Motor-cyclists. The Importance of the Crash Helmet. *Br Med J.* 1941 Oct 4;2(4213):465-71. doi: [10.1136/bmj.2.4213.465](https://doi.org/10.1136/bmj.2.4213.465). PMID: 20783886; PMCID: PMC2163030.

As survival from severe brain trauma improved, clinicians were faced with the situation where some patients would ‘recover from sleep-like coma’ but never ‘regain recognisable mental function.’ Jennett and Plum defined persistent vegetative state for the first time, laying the ground for a veritable explosion of knowledge around consciousness, in clinical practice and ethics.

35. Jennett B, Plum F. Persistent vegetative state after brain damage. A syndrome in search of a name. *Lancet.* 1972 Apr 1;1(7753):734-7. doi: [10.1016/s0140-6736\(72\)90242-5](https://doi.org/10.1016/s0140-6736(72)90242-5). PMID: 4111204.

Douglas Miller’s classic overview with Prof Tom Langfitt of cerebral perfusion pressure laid the foundations for non-operative management of acute intracranial lesions and modern neuro-intensive care. As continuous monitoring of intracranial pressure (ICP) became increasingly common, it was recognised that Intracranial hypertension, rather than the underlying disorder, might be primarily responsible for death. There was general agreement that the intracranial hypertension disturbed brain function by reducing cerebral blood flow (CBF), the effects being mediated through alterations in cerebral perfusion pressure (CPP).

36. Miller, J.Douglas, Albert Stanek, and Thomas W. Langfitt. 1972. Concepts of Cerebral Perfusion Pressure and Vascular Compression During Intracranial Hypertension. 35: 411–432. doi:[10.1016/s0079-6123\(08\)60102-8](https://doi.org/10.1016/s0079-6123(08)60102-8).

In 1973, Crockard and colleagues published the first report measuring Intracranial Pressure in patients with acute head injuries treated by controlled mechanical ventilation. ICP reduction and low cerebrospinal fluid lactate were associated with increased survival. This work predated general acceptance of these treatment strategies. In patients who survived, mechanical ventilation was associated with a rapid reduction in intracranial pressure.

37. Crockard HA, Coppel DL, Morrow WF. Evaluation of hyperventilation in treatment of head injuries. *Br Med J.* 1973 Dec 15;4(5893):634-40. doi: [10.1136/bmj.4.5893.634](https://doi.org/10.1136/bmj.4.5893.634). PMID: 4758542; PMCID: PMC1587619.

More than fifty years since Teasdale and Jennett proposed the Glasgow Coma Scale in 1974, it is the most widely used tool for assessment of consciousness across the world. Its success is a testament to its simplicity,

and its effectiveness at identifying clinically important changes in a patient's conscious level, to guide management, as well as to make estimations of a patient's likely outcome. Since 2014, the GCS Aid has provided a framework for the reliable and reproducible assessment of the GCS, and has been translated into more than 40 languages.

38. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet*. 1974 Jul 13;2(7872):81-4. doi: [10.1016/s0140-6736\(74\)91639-0](https://doi.org/10.1016/s0140-6736(74)91639-0). PMID: 4136544.

39. G Teasdale, D Allan, PM Brennan, E McElhinney *Nursing Times* 2016 110 (42), 12-16 Forty years on: updating the Glasgow Coma Scale – (GCS Aid reference)

Following on from the seminal GCS paper, Jennett and Bond proposed the original Glasgow Outcome Scale (GOS) for assessment of outcome after severe brain damage. They noted that the lack of an objective scale led to vague and over-optimistic estimates of outcome, obscuring the ultimate results of early management. In this paper they describe the rationale for the original 5 point scale which is now the bedrock of outcome assessment for brain injury.

40. Jennett B, Bond M. Assessment of outcome after severe brain damage. *Lancet*. 1975 Mar 1;1(7905):480-4. doi: [10.1016/s0140-6736\(75\)92830-5](https://doi.org/10.1016/s0140-6736(75)92830-5). PMID: 46957.

Survivors of cranial gunshot wounds often had large skull defects which posed considerable problems for the contemporary conventional acrylic, rib or silastic repair. With titanium "offcuts" from the manufacture of Concorde wings, a mould of the defect was used to shape the plate. Fortunately, the implant was radiolucent and compatible with MRI scanning.

41. Blair GA, Fannin TF, Gordon DS. Titanium-strip cranioplasty. *Br Med J*. 1976 Oct 16;2(6041):907-8. doi: [10.1136/bmj.2.6041.907](https://doi.org/10.1136/bmj.2.6041.907). PMID: 974656; PMCID: PMC1688525.

Only 3 years after the publication of the GCS paper, Jennett, Teasdale and colleagues from the UK, US and the Netherlands published a comparative cohort study of 700 patients with severe head injuries from the three countries, all of whom had their level assessed using the GCS. There was a close similarity between the initial features of patients in the three countries and in spite of differences in organisation of care and management, the mortality was exactly the same.

42. Jennett B, Teasdale G, Galbraith S, Pickard J, et al Severe head injuries in three countries. *J Neurol Neurosurg Psychiatry*. 1977 Mar;40(3):291-8. doi: [10.1136/jnnp.40.3.291](https://doi.org/10.1136/jnnp.40.3.291). PMID: 886355; PMCID: PMC492665.

Building on the patient cohort report in their 1977 paper, in 1979 Jennett and colleagues published a study of 1000 patients where they analysed the relationship between clinical features of brain dysfunction in the first week after severe head injury, and outcome 6 months later. Depth of coma, pupil reaction, eye movements, motor response pattern and patient age were the most reliable predictors. The degree of brain dysfunction changes markedly soon after injury. More reliable predictions of outcome are possible when assessment is based on the best level of functioning recorded in each early epoch. Predictions based on very early assessment are often unduly pessimistic.

43. Jennett B, Teasdale G, Braakman R, Minderhoud J, Heiden J, Kurze T. Prognosis of patients with severe head injury. *Neurosurgery*. 1979 Apr;4(4):283-9. doi: [10.1227/00006123-197904000-00001](https://doi.org/10.1227/00006123-197904000-00001). PMID: 450225.

The type of intracranial haematoma is important for determining a patient's outcome. In this 1979 paper outcomes were analysed for patients with an extradural haematoma treated in the Lothian region, South East

Scotland between 1951 and 1977. The authors assessed the effect of delays in treatment. 83 patients were included who had supratentorial extradural haematomas, and no contusions or intradural clots. The mean delay in patients who died was 15.7 hours, but only 1.9 hours in good-quality survivors. Over time, the mean time to surgery reduced and outcomes improved. The need for immediate operations in patients deteriorating with extradural haematomas was clear, underscoring the advantage of direct admission to a specialist unit. The NICE Guidelines for management of head injury have used this information in all six editions from 1989 onward, advising CT scan of the head within 1 hour of risk factor identification.

44. Mendelow AD, Gillingham FJ. Extradural haematoma: effect of delayed treatment. *Br Med J*. 1979 Jul 14;2(6182):134. doi: [10.1136/bmj.2.6182.134-a](https://doi.org/10.1136/bmj.2.6182.134-a). PMID: 466317; PMCID: PMC1596072.

By 1983, the GCS had been widely accepted. In many centres the eye, verbal, and motor components were being summed. This letter to the *Lancet* addressed the issue of the important information being lost in the process of summing the component scores of the GCS. Summing assumes an equal weighting for the three responses, but in fact they are each most useful at different points in the deterioration of a patient's conscious level. The information conveyed by the coma score is less than that contained in the three responses separately, because the same score may be made up in different ways.

45. Teasdale G, Jennett B, Murray L, Murray G. Glasgow coma scale: to sum or not to sum. *Lancet*. 1983 Sep 17;2(8351):678. doi: [10.1016/s0140-6736\(83\)92550-3](https://doi.org/10.1016/s0140-6736(83)92550-3). PMID: 6136811.

To determine whether a patient will develop a surgically significant intracranial haematoma after a head injury, a study of approximately 6000 head injured patients found that a skull fracture and the conscious level, were key factors. With radiological evidence of skull fracture and any impairment of consciousness, one patient in four will develop a haematoma. With neither feature, the risk is one in 6000. This work contributed to the process of risk stratification, which saved both patient lives and healthcare resources.

46. Mendelow AD, Teasdale G, Jennett B, Bryden J, Hessett C, Murray G. Risks of intracranial haematoma in head injured adults. *Br Med J (Clin Res Ed)*. 1983 Oct 22;287(6400):1173-6. doi: [10.1136/bmj.287.6400.1173](https://doi.org/10.1136/bmj.287.6400.1173). PMID: 6414615; PMCID: PMC1549389.

This study of normobaric hyperoxia treatment of severe head injury tested the hypothesis that normobaric hyperoxia in human patients alters the indices of brain oxidative metabolism. The study contributed significantly to our understanding of human TBI, which led to improvements in the management of these patients.

47. Tolias CM, Reinert M, Seiler R, Gilman C, Scharf A, Bullock MR. Normobaric hyperoxia--induced improvement in cerebral metabolism and reduction in intracranial pressure in patients with severe head injury: a prospective historical cohort-matched study. *J Neurosurg*. 2004 Sep;101(3):435-44. doi: [10.3171/jns.2004.101.3.0435](https://doi.org/10.3171/jns.2004.101.3.0435). PMID: 15352601.

Patel and colleagues used TARN (Trauma Audit and Research Network) data to define and clarify the need for head injury care to be in neurosurgical centres. The paper provided supporting evidence for the subsequent development of Major Trauma Centres in the UK, and the central role of head injury care in patient outcomes.

48. Patel HC, Bouamra O, Woodford M, King AT, Yates DW, Lecky FE; Trauma Audit and Research Network. Trends in head injury outcome from 1989 to 2003 and the effect of neurosurgical care: an observational study. *Lancet*. 2005 Oct 29-Nov 4;366(9496):1538-44. doi: [10.1016/S0140-6736\(05\)67626-X](https://doi.org/10.1016/S0140-6736(05)67626-X). Erratum in: *Lancet*. 2006 Mar 11;367(9513):816. PMID: 16257340.

The CRASH-1 trial (Corticosteroid Randomisation After Significant Head Injury) was a landmark randomized controlled trial in neurosurgery that investigated the role of corticosteroids in traumatic brain injury, a treatment that prior to the trial was used in up to 60% of moderate to severe cases. Conducted across 175 hospitals in 29 countries and enrolling over 10,000 patients, the trial found that high-dose methylprednisolone was associated with significantly higher mortality at 2 weeks compared to placebo (21.1% vs 17.9%; relative risk 1.18, 95% CI 1.09–1.27). Importantly, this excess mortality persisted at 6 months, with no evidence of late recovery benefit or improved neurological outcomes. These findings led to the immediate cessation of corticosteroid use with a rapid, worldwide shift in practice. CRASH-1 also set a new benchmark for emergency trauma trials, showing methodological simplicity, and successful collaboration across high- and low-resource settings laid the foundations for future large-scale, pragmatic evaluations in trauma.

49. Roberts I, Yates D, Sandercock P, Farrell B, et al; CRASH trial collaborators. Effect of intravenous corticosteroids on death within 14 days in 10008 adults with clinically significant head injury (MRC CRASH trial): randomised placebo-controlled trial. *Lancet*. 2004 Oct 9-15;364(9442):1321-8. doi: [10.1016/S0140-6736\(04\)17188-2](https://doi.org/10.1016/S0140-6736(04)17188-2). PMID: 15474134.

Santarius' seminal study of the use of drains after burr-hole evacuation of chronic subdural haematoma was one of the first trials to challenge neurosurgical dogma and paradigms handed down from mentor to trainee. The trial showed that the use of a drain after burr-hole drainage of chronic subdural haematoma is safe and associated with reduced recurrence and mortality at 6 months. The findings have changed practice (e.g. PMC5350212) and have been incorporated into guidelines including the ICENI guidelines. Burrhole drainage with the use of a drain should be considered as first-line surgical management.

50. Santarius T, Kirkpatrick PJ, Ganesan D, Chia HL et al. Use of drains versus no drains after burr-hole evacuation of chronic subdural haematoma: a randomised controlled trial. *Lancet*. 2009 Sep 26;374(9695):1067-73. doi: [10.1016/S0140-6736\(09\)61115-6](https://doi.org/10.1016/S0140-6736(09)61115-6). PMID: 19782872.

Following Santarius' study, the first task of the newly founded British Neurosurgical Trainee Research Collaborative group was a prospective multicentre study of 1,205 patients with chronic subdural haematoma across 26 UK and Irish neurosurgical units. The study established contemporary national outcomes for CSDH and provided evidence supporting routine subdural drainage. Importantly, the study highlighted potentially modifiable aspects of perioperative care, many of which have now been tested in prospective randomised trials around the world.

51. Brennan PM, Kolas AG, Joannides AJ, Shapey J, et al; British Neurosurgical Trainee Research Collaborative. The management and outcome for patients with chronic subdural hematoma: a prospective, multicenter, observational cohort study in the United Kingdom. *J Neurosurg*. 2017 Oct;127(4):732-739. doi: [10.3171/2016.8.JNS16134](https://doi.org/10.3171/2016.8.JNS16134). Epub 2016 Nov 11. PMID: 27834599.

RESCUEicp was a landmark study of decompressive craniectomy for traumatic intracranial hypertension. Patients with traumatic brain injury, and raised and refractory intracranial pressure, were randomised to advanced medical management (including barbiturates) in one arm and decompressive craniectomy in the other arm. The results showed that decompressive craniectomy reduced mortality when compared with medical treatment, with a spectrum of outcome in the survivors and an improvement in outcome between 6, 12 and 24 months, saving 22 additional lives out of 100, with 66% of survivors independent at home or better. The frequency of this operation has increased (in the UK 14%) and it has been incorporated into clinical guidelines including the decompressive craniectomy consensus statement, the Brain Trauma Foundation Guidelines and the Trauma Quality Improvement Programme.

- 52.** Hutchinson PJ, Koliass AG, Timofeev IS, Corteen EA, et al; RESCUEicp Trial Collaborators. Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension. *N Engl J Med*. 2016 Sep 22;375(12):1119-30. doi: [10.1056/NEJMoa1605215](https://doi.org/10.1056/NEJMoa1605215). Epub 2016 Sep 7. PMID: 27602507.

Neurosurgeons confront significant clinical and ethical dilemmas in reconciling aggressive operative intervention with patients' anticipated quality of life and care preferences. Precise prognostication of long-term functional outcomes, rather than mortality alone, is indispensable for guiding surgical decision-making, facilitating informed discussions with families, and addressing the disproportionately high residual disability observed in this demographic. Brennan, Murray and Teasdale simplified the use of prognostic information in traumatic brain injury by developing the GCS -Pupils score, an extended index of clinical severity that can be determined easily at the patient bedside, and which performs similar to more complicated prediction tools. They provided charts that graphically presented probabilities of functional and mortality outcomes, based on GCS-P, age and CT imaging findings.

- 53.** Brennan PM, Murray GD, Teasdale GM. Simplifying the use of prognostic information in traumatic brain injury. Part 1: The GCS-Pupils score: an extended index of clinical severity. *J Neurosurg*. 2018 Jun;128(6):1612-1620. doi: [10.3171/2017.12.JNS172780](https://doi.org/10.3171/2017.12.JNS172780). Epub 2018 Apr 10. PMID: 29631516.
- 54.** Murray GD, Brennan PM, Teasdale GM. Simplifying the use of prognostic information in traumatic brain injury. Part 2: Graphical presentation of probabilities. *J Neurosurg*. 2018 Jun;128(6):1621-1634. doi: [10.3171/2017.12.JNS172782](https://doi.org/10.3171/2017.12.JNS172782). Epub 2018 Apr 10. PMID: 29631517.

This trial studied the role of Dexamethasone for Chronic Subdural Hematoma and made surgeons think twice about how a 'common sense' approach to a clinical problem (i.e. prescribing dexamethasone to stop swelling in CSDH) does not necessarily make it the correct treatment. Patients with chronic subdural haematoma were randomised to either placebo or dexamethasone. The results showed that among adults with symptomatic chronic subdural hematoma, most of whom had undergone surgery to remove their hematomas during the index admission, treatment with dexamethasone resulted in fewer favourable outcomes and more adverse events than placebo at 6 months, but fewer repeat operations were performed in the dexamethasone group. The trial has changed practice, with steroids now rarely prescribed. The findings have been incorporated into guidelines including the ICENI guidelines. Corticosteroids should not be used to treat symptomatic CSDH, either for non-operative management or as an adjuvant to operative management. The trial established the role of the neurosurgical trainee research collaborative (BNTRC), by recruiting trainees in all neurosurgical units to enrol patients.

- 55.** Hutchinson PJ, Edlmann E, Bulters D, Zolnourian A, et al. Trial of Dexamethasone for Chronic Subdural Hematoma. *N Engl J Med*. 2020 Dec 31;383(27):2616-2627. doi: [10.1056/NEJMoa2020473](https://doi.org/10.1056/NEJMoa2020473). Epub 2020 Dec 16. PMID: 33326713.

A trial for patients with traumatic acute subdural hematoma randomised patients undergoing surgery to craniotomy (bone back) or decompressive craniectomy (bone out). The results showed that disability and quality-of-life outcomes were similar with the two approaches. Additional surgery was performed in a higher proportion of the craniotomy group (although relatively few patients) and more wound complications occurred in the craniectomy group. The practice changing implications of this trial are that the bone flap can be replaced in the absence of brain swelling, thereby avoiding primary decompressive craniectomy and later cranioplasty for most patients. The trial findings have been incorporated into the Trauma Quality Improvement Programme guidelines

56. Hutchinson PJ, Adams H, Mohan M, Devi BI, et al Decompressive Craniectomy versus Craniotomy for Acute Subdural Hematoma. *N Engl J Med*. 2023 Jun 15;388(24):2219-2229. doi: [10.1056/NEJMoa2214172](https://doi.org/10.1056/NEJMoa2214172). Epub 2023 Apr 23. PMID: 37092792.

Cerebrospinal fluid

Assessment and management of cerebrospinal fluid disorders has been a critical component of general neurosurgical practice for decades. Nulsen and Spitz introduced the first successful valve-regulated shunt. Silicone tubing and ventriculoperitoneal systems followed in the 1950s. Programmable and gravitational valves later reduced over drainage complications. Concurrently, endoscopic third ventriculostomy (ETV) emerged as a shunt-independent option for obstructive hydrocephalus. Antibiotic-impregnated catheters, neuronavigation, and multimodality imaging further improved outcomes, shifting practice toward individualized, minimally invasive strategies that minimize morbidity and revision rates.

In 1976, Bernard Williams, in the West Midlands, investigated the effect of coughing on cerebrospinal fluid pressure changes. CSF pressure recordings were taken from the lumbar region and the cisterna magna of 16 patients during coughing in the sitting position. He reported that there was a phase during which the lumbar pressure exceeds the cisternal, followed by one in which the cisternal exceeds the lumbar. He realised that this may be relevant in the aetiology of cord destruction in syringomyelia, amongst other conditions, and that assessment of a cough impulse might be a more sensitive indicator of spinal blockage than Queckenstedt's test, in the time before ubiquitous MRI imaging.

57. Williams B. Cerebrospinal fluid pressure changes in response to coughing. *Brain*. 1976 Jun;99(2):331-46. doi: [10.1093/brain/99.2.331](https://doi.org/10.1093/brain/99.2.331). PMID: 990900.

Infection of cerebrospinal fluid shunts has challenged patients and neurosurgeons for decades. In neonates, one of the most affected groups of patients, a 1992 study of risk factors examined data from 446 consecutive shunt operations in 294 children. The infection rate for infants younger than 6 months old was 15.7% (28 of 178 procedures), compared with 5.6% (16 of 288 procedures) for older children ($p = 0.0005$). 110 strains of coagulase-negative *Staphylococcus* isolated from the skin of 53 children before surgery were then tested for bacterial adherence. 67% of all infections were due to coagulase-negative *Staphylococcus*, and the inference was made that there was selection of more virulent strains of coagulase-negative *Staphylococcus* on the skin of neonates. Prevention of shunt infections in this high-risk group might be facilitated by the reduction of skin bacterial density before surgery.

58. Pople IK, Bayston R, Hayward RD. Infection of cerebrospinal fluid shunts in infants: a study of etiological factors. *J Neurosurg*. 1992 Jul;77(1):29-36. doi: [10.3171/jns.1992.77.1.0029](https://doi.org/10.3171/jns.1992.77.1.0029). PMID: 1607969.

Other than shunts for CSF diversion, another treatment of childhood hydrocephalus investigated was choroid plexus coagulation and artificial cerebrospinal fluid perfusion. Huw Griffith, founder of the British Journal of Neurosurgery, was a pioneer of neuroendoscopy and one of the most innovative neurosurgeons of his generation. During an illustrious career in Bristol he was the first UK neurosurgeon to master endoscopic Choroid Plexus Coagulation (CPC). This study drew attention to this alternative treatment for hydrocephalus, defining the effectiveness of ECPC, and sparking further research into the procedure's efficacy, such as combining it with endoscopic third ventriculostomy (ETV). A 1994 publication of a 20 year retrospective review of 156 cases of paediatric hydrocephalus managed at Frenchay (Bristol) hospital, reported that ETV with CPC was successful in the control of hydrocephalus (therefore shunt prevention) in a select group of infants with slowly progressive communicating hydrocephalus.

59. Griffith HB, Jamjoom AB. The treatment of childhood hydrocephalus by choroid plexus coagulation and artificial cerebrospinal fluid perfusion. *Br J Neurosurg*. 1990;4(2):95-100. doi: [10.3109/02688699008992706](https://doi.org/10.3109/02688699008992706). PMID: 2357290.

- 60.** Pople IK, Ettles D. The role of endoscopic choroid plexus coagulation in the management of hydrocephalus. *Neurosurgery*. 1995 Apr;36(4):698-701; discussion 701-2. doi: [10.1227/00006123-199504000-00009](https://doi.org/10.1227/00006123-199504000-00009). PMID: 7596499.

In 2001, Javadpour and colleagues reported an evaluation of ETV as a primary treatment for hydrocephalus in children less than 1 year old. Data were collected prospectively on 47 infants, 21 having ETV, and the remainder a ventriculoperitoneal shunt. During a median follow-up of 18 months 33% of ETVs remained patent. In 11 of those with ETV failure a ventriculoperitoneal shunt was inserted, whilst 3 underwent successful 're-do' ETV. In patients with congenital aqueduct stenosis there was a 71% success rate, but only 10% in post-haemorrhagic hydrocephalus. This landmark report evidenced that ETV was safe and can lead to a reduction in the shunted population. Success of ETV is aetiology, not age dependent.

- 61.** Javadpour M, Mallucci C, Brodbelt A, Golash A, May P. The impact of endoscopic third ventriculostomy on the management of newly diagnosed hydrocephalus in infants. *Pediatr Neurosurg*. 2001 Sep;35(3):131-5. doi: [10.1159/000050406](https://doi.org/10.1159/000050406). PMID: 11641621.

The pioneers of CSF diversion were focused on treating children with hydrocephalus, and over time the indications for surgery have expanded, for example to include idiopathic normal pressure hydrocephalus. In a 2024 systematic review of 4 RCTs to examine the effect of CSF-shunting versus no CSF-shunting in people with iNPH, the authors reported moderate-certainty evidence that CSF-shunting likely improves gait speed and disability in iNPH in the relative short term. Future studies are still needed.

- 62.** Pearce RKB, Gontsarova A, Richardson D, Methley AM, Watt HC, Tsang K, Carswell C. Shunting for idiopathic normal pressure hydrocephalus. *Cochrane Database Syst Rev*. 2024 Aug 6;8(8):CD014923. doi: [10.1002/14651858.CD014923.pub2](https://doi.org/10.1002/14651858.CD014923.pub2). PMID: 39105473; PMCID: PMC11301990.

For idiopathic intracranial hypertension (IIH), CSF diversion is a mainstay of treatment in patients who do not respond to strategies such as weight loss or pharmacological reduction in CSF production. In 2002, Higgins and colleagues proposed a novel strategy, reporting the first published case of cerebral venous sinus stenting for IIH. This technique is now being used around the world, not only for IIH but also for many other pathologies associated with venous sinus narrowing. The IIH Intervention trial comparing CSF shunting and venous sinus stenting is now recruiting and expected to report in 2030.

- 63.** Higgins JN, Owler BK, Cousins C, Pickard JD. Venous sinus stenting for refractory benign intracranial hypertension. *Lancet*. 2002 Jan 19;359(9302):228-30. doi: [10.1016/S0140-6736\(02\)07440-8](https://doi.org/10.1016/S0140-6736(02)07440-8). PMID: 11812561.

As CSF diversion has become embedded into routine practice, the UK neurosurgical community has made pivotal contributions to establishing best practice to improve patient outcomes. In 2017, the British Neurosurgical Trainee Research Collaborative (BNTRC), published data which set the benchmark in external ventricular drainage (EVD) practice and cemented the role of trainee-led research in UK neurosurgery. In this prospective, multicentre study of EVD-related infections, data from 21 neurosurgical units across the UK and Ireland was analysed. 495 EVD catheters were inserted into 452 patients, for a median 8 day (IQR 4-13). Of the catheters inserted, 188 (38%) were antibiotic-impregnated, 161 (32.5%) were plain and 146 (29.5%) were silver-bearing. Factors independently associated with increased infection risk included duration of EVD placement for ≥ 8 days (HR=2.47 (1.12-5.45); $p=0.03$), regular sampling (daily sampling (HR=4.73 (1.28-17.42), $p=0.02$) and alternate day sampling (HR=5.28 (2.25-12.38); $p<0.01$). There was no association between catheter type or tunnelling distance and ERI, but a later, powered prospective trial would provide further insight into the role of catheter type in CSF infection.

64. Jamjoom AAB, Joannides AJ, Poon MT, Chari A, et al; British Neurosurgical Trainee Research Collaborative. Prospective, multicentre study of external ventricular drainage-related infections in the UK and Ireland. *J Neurol Neurosurg Psychiatry*. 2018 Feb;89(2):120-126. doi: [10.1136/jnnp-2017-316415](https://doi.org/10.1136/jnnp-2017-316415). Epub 2017 Oct 25. PMID: 29070645; PMCID: PMC5800336.

Insertion of a ventriculoperitoneal shunt for hydrocephalus is one of the commonest neurosurgical procedures worldwide, but infection affects up to 15% of patients. The multi-centre BASICS trial randomised patients to receive standard, antibiotic-impregnated (0.15% clindamycin and 0.054% rifampicin), or silver-impregnated shunts. Participants were followed for 6 months to 2 years. 1605 patients were randomly assigned and antibiotic shunts reduced the infection rate to 2%, whilst silver and plain shunts did not (6% infection rate). Antibiotic shunts are now the standard of care. A follow-up study using UK shunt registry data shows that antibiotic shunts work in routine clinical practice.

65. Mallucci CL, Jenkinson MD, Conroy EJ, Hartley JC, et al; BASICS Study collaborators. Antibiotic or silver versus standard ventriculoperitoneal shunts (BASICS): a multicentre, single-blinded, randomised trial and economic evaluation. *Lancet*. 2019 Oct 26;394(10208):1530-1539. doi: [10.1016/S0140-6736\(19\)31603-4](https://doi.org/10.1016/S0140-6736(19)31603-4). Epub 2019 Sep 12.
66. Bakhsh A, Fernández Méndez R, Culeddu G, et al. Clinical and health economic impact of the BASICS trial on ventriculoperitoneal shunt surgery: UK Shunt Registry analysis. *J Neurosurg*. 2026 Jan 23;144(6):1506-1516. doi: [10.3171/2025.8.JNS251266](https://doi.org/10.3171/2025.8.JNS251266). PMID: 41576382.

Skull base

Over the past century, Schloffer, Cushing and others laid the foundations for transsphenoidal approaches, while the introduction of the operating microscope and high-speed drills by Kurze and Yaşargil led the way for precise microsurgical access with reduced morbidity. Multidisciplinary collaboration with otolaryngologists expanded the corridors for surgical approach. Purely endoscopic endonasal techniques revolutionised midline approaches, minimizing brain retraction, whilst neuronavigation, intraoperative neuromonitoring, and vascularized nasoseptal flaps have further improved outcomes. British neurosurgeons have made some seminal contributions on this journey.

A seminal paper, “A Study of Intracranial Surgery” by Hugh Cairns described Cushing-inspired modern neurosurgery as learnt by Cairns in Boston. The work strongly promoted the import of these approaches to the UK. The paper was rejected by the board of the BJS as it was too controversial, and it was eventually published in this unusual format to gain a British audience.

67. A study of intracranial surgery. By Hugh Cairns. Royal 8vo. pp. 83, with 37 illustrations. Issued by the Privy Council Medical Research Council. 1929. London: H.M. Stationery Office. 3s. net, British Journal of Surgery, Volume 16, Issue 64, April 1929, Page 700, <https://doi.org/10.1002/bjs.1800166424>

In 1939 WR Henderson of Leeds reported on pituitary adenomata, with a follow up study of the surgical results in 338 cases from Dr Harvey Cushing (operated 1913–1932), who he visited at Yale. Operative mortality was low (approximately 4.9% for chromophobe and 8.6% for acidophil tumours), with visual improvement observed in about 65% of patients at six months. Longer-term results demonstrated substantial recurrence rates highlighting the later benefits of adjuvant measures.

68. W R Henderson, The pituitary adenomata. A follow-up study of the surgical results in 338 cases. (DR. HARVEY CUSHING's SERIES), British Journal of Surgery, Volume 26, Issue 104, April 1939, Pages 811–921, <https://doi.org/10.1002/bjs.18002610417>

Sir Geoffrey Jefferson, founding father of the SBNS and his 'Selected papers' (1960), published by Pitman is a 'must read.' His 1940 President's Address to the Royal Society of Medicine addressing Extrasellar Extensions of Pituitary Adenomas is just one of his many pivotal clinico-physiological-pathological studies, and essays about medicine and philosophy in general. Jefferson defines extrasellar extensions of pituitary adenomas, present in about 14% of his 128 cases. He proposed that these extensions arise from the adenoma's growth potential, chiasmal fixation and sellar anatomy, markedly altering clinical features, worsening long-term prognosis and raising operative mortality, and thereby forming an essential part of the natural history of pituitary adenomas.

69. Geoffrey Jefferson, M.S. Extrasellar Extensions of Pituitary Adenomas. Proc RSM, Volume 33, Issue 7 <https://doi.org/10.1177/003591574003300717>

There have been significant contributions to technical developments in other skull base surgery. A technical note on the translabyrinthine-transtentorial approach to cerebellopontine angle by Morrison and King in 1973 demonstrated the value of the translabyrinthine technique in removing tumours in the cerebellopontine angle

with low morbidity and no mortality. This popularised the technique within the UK and further afield. It is an early example of the benefits of multi-disciplinary working in subspecialty skull base surgery.

- 70.** Morrison AW, King TT. Experiences with a translabyrinthine-transtentorial approach to the cerebellopontine angle. Technical note. *J Neurosurg.* 1973 Mar;38(3):382-90. doi: [10.3171/jns.1973.38.3.0382](https://doi.org/10.3171/jns.1973.38.3.0382). PMID: 4541277.

Neurovascular decompression in trigeminal neuralgia- a clinical and anatomical study by Hamlyn and colleagues in 1992 combined clinical and cadaveric anatomical study to compare the anatomical relationship of blood vessels to the trigeminal nerve in patients with and without trigeminal neuralgia. It provided compelling evidence of the role of vascular compression in the aetiology of this condition and the role of decompressive surgery.

- 71.** Hamlyn, P. J., & King, T. T. (1992). Neurovascular compression in trigeminal neuralgia: a clinical and anatomical study. *Journal of Neurosurgery*, 76(6), 948-954. <https://doi.org/10.3171/jns.1992.76.6.0948>

Although Microvascular Decompression (MVD) for Trigeminal Neuralgia (TGN) had been described by Janetta in the 1970s, the procedure was not readily accepted by the British Neurosurgical community. Long-term outcomes were uncertain and many were sceptical of the concept of TGN being due to vascular compression. Sarsam, Eldridge and colleagues' 2010 paper advanced the position of the treatment of TGN by MVD in the UK and worldwide, with one of the then largest cohorts of patients. They showed the long-term benefits of MVD for TGN, using the gold standard outcome measure- to be pain free and off medication. The paper highlighted earlier work from the Liverpool group regarding the importance of making a correct diagnosis, charted the introduction from the same unit of MRI imaging in TGN, noted that chronological age was not a contraindication to the procedure, and described some physiological insights produced by the group into the aetiology of TGN including recovery of the subtle but impaired sensory function of the nerve. This paper, along with others, led to newer classifications of the diagnosis of TGN. This included TGN syndrome with neurovascular distortion of the nerve (classical), simple contact, and an (idiopathic) group often younger and with female predominance who had at best equivocal or negative MRI findings. With a large cohort of patients and good long term follow up, this paper established MVD as the gold standard treatment option for patients with drug resistant or drug intolerant TGN.

- 72.** Sarsam Z, Garcia-Fiñana M, Nurmikko TJ, Varma TR, Eldridge P. The long-term outcome of microvascular decompression for trigeminal neuralgia. *Br J Neurosurg.* 2010 Feb;24(1):18-25. doi: [10.3109/02688690903370289](https://doi.org/10.3109/02688690903370289). PMID: 20158348.

Moving to a different cranial nerve, intriguingly, inflammation is hypothesized to be a key event in the growth of sporadic vestibular schwannoma (VS). Lewis and colleagues from Manchester studied the relationship between inflammation and tumour growth in vivo using the PET tracer 11C-(R)-PK11195 and dynamic contrast enhanced (DCE) MRI derived vascular biomarkers, in 19 patients. Compared with static tumours, growing VSs displayed significantly higher mean inflammation, which provides new insights that might inform future treatment strategies.

- 73.** Lewis D, Roncaroli F, Agushi E, Mosses D, et al. Inflammation and vascular permeability correlate with growth in sporadic vestibular schwannoma. *Neuro Oncol.* 2019 Feb 19;21(3):314-325. doi: [10.1093/neuonc/nyy177](https://doi.org/10.1093/neuonc/nyy177). PMID: 30388263; PMCID: PMC6380424.

In the era of subspecialisation and multi-disciplinary clinics, this study of an evaluation of the clinical and molecular predictors of risk of mortality in people with neurofibromatosis 2 (NF2) analysed 368 patients from 261 families in the United Kingdom NF2 registry. The relative risk of mortality in patients treated at specialty centres was 0.34 compared with those treated at non-specialty centres (95% CI 0.12-0.98). Age at diagnosis

was the strongest single predictor of the risk of mortality, but to ensure optimal care, people with NF2 were recommended to be referred to specialty treatment centres. This paper that led to the centralisation of NF2 care in specialist centres and subsequent proven transformation of morbidity and mortality

- 74.** Baser ME, Friedman JM, Aeschliman D, Joe H, Wallace AJ, Ramsden RT, Evans DG. Predictors of the risk of mortality in neurofibromatosis 2. *Am J Hum Genet.* 2002 Oct;71(4):715-23. doi: [10.1086/342716](https://doi.org/10.1086/342716). Epub 2002 Aug 22. PMID: 12235555; PMCID: PMC378530.

Vascular

Vascular neurosurgery advanced dramatically with the introduction of the operating microscope and refined aneurysm clips by Yaşargil in the 1960s-70s. The subsequent endovascular revolution, marked by Guglielmi detachable coils in the 1990s, flow-diverting stents, and mechanical thrombectomy devices, shifted treatment toward minimally invasive options. Many challenges still exist, such as optimising patient stratification for treatments and resolving delayed ischaemic deficits. British neurosurgeons are at the forefront of the research, as over the past 100 years.

Before clipping and endovascular treatments, Victor Horsley first accomplished inducing thrombosis within an aneurysm in 1885 by occluding the cervical carotid artery to treat an ipsilateral intracranial aneurysm. Edinburgh's Norman Dott later described management of eight cases of ruptured aneurysms in a 1933 monograph. The outcomes varied from death to excellent recovery. With detailed descriptions of the post-mortem pathology, this provides an intriguing historical insight into the use of carotid ligation, and to Dott's classic description of obliterating a ruptured aneurysm with muscle - the patient survived and led a very productive life for many years.

75. Dott NM. Intracranial Aneurysms: Cerebral Arterio-Radiography: Surgical Treatment. *Edinb Med J.* 1933 Dec;40(12):T219-T240. PMID: [29647075](#); PMCID: PMC5306867.

Walter Dandy performed the first intracranial clipping of an aneurysm in 1937. Treatment of aneurysmal subarachnoid haemorrhage by clip occlusion of the feeding vessel was guided by ventriculography and angiography. In 1956, a major paper by Valentine Logue reported his operative experience treating patients with aneurysmal subarachnoid haemorrhage. The historical control group (n=36) managed with 6 weeks bed rest had a 44% mortality rate compared to 13.5% in the operated group (n=37). Although the study was not randomised, surgical intervention was superior to no surgery, paving the way for the growth of aneurysm surgery.

76. LOGUE V. Surgery in spontaneous subarachnoid haemorrhage; operative treatment of aneurysms on the anterior cerebral and anterior communicating artery. *Br Med J.* 1956 Mar 3;1(4965):473-9. doi: [10.1136/bmj.1.4965.473](#). PMID: 13293357; PMCID: PMC1979127.

In 1960, Wylie McKissock, pioneer of structured clinical trials and founder of the Atkinson Morley Hospital, reported a controlled trial of the conservative and surgical treatment of ruptured aneurysms of the internal carotid artery at or near the point of origin of the Posterior Communicating Artery. This was probably the first UK trial of a neurosurgical procedure, and included objective assessment of patients after 6 months by an independent neurologist. Morbidity was lower for patients treated surgically.

77. McKissock W, Richardson A, Walsh L. "Posterior- Communicating" aneurysms. A Controlled Trial of the Conservative and Surgical Treatment of Ruptured Aneurysms of the Internal Carotid Artery at or near the point of origin of the Posterior Communicating Artery. *Lancet* 275 (7136); 1203-1206. doi.org/[10.1016/S0140-6736\(60\)91094-1](#)

More than 40 years later, the pendulum was to swing away from the primacy of surgical clipping. The International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling randomised 2143 patients with ruptured intracranial aneurysms. Coiling resulted in better clinical outcomes at

one year, and the study led to a significant change in practice and neurosurgical services, with the growth of interventional neuroradiology.

- 78.** Molyneux A, Kerr R, Stratton I, Sandercock P, Clarke M, Shrimpton J, Holman R; International Subarachnoid Aneurysm Trial (ISAT) Collaborative Group. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. *Lancet*. 2002 Oct 26;360(9342):1267-74. doi: [10.1016/s0140-6736\(02\)11314-6](https://doi.org/10.1016/s0140-6736(02)11314-6). PMID: 12414200.

There remain challenges in optimising outcomes for patients with aneurysmal subarachnoid haemorrhage. A key to understanding the effects of rupture, and the consequences of aneurysm treatment, has been to elucidate the critical physiological and pathophysiological processes. In 1981 Lindsay Symon and colleagues made a seminal contribution by coining the term 'ischaemic penumbra' to describe the potential zone of recovery around an ischaemic region - a term still used today. A model of acute focal ischemia in the territory of the anterior cerebral artery in baboons supported development of the concept. Demonstration of the ischemic penumbra revolutionised our thinking of the brain and its blood flow, what happens during stroke, and what might be "salvageable" brain. This has directly influenced how to manage stroke to minimise disability.

- 79.** Astrup J, Siesjö BK, Symon L. Thresholds in cerebral ischemia - the ischemic penumbra. *Stroke*. 1981 Nov-Dec;12(6):723-5. doi: [10.1161/01.str.12.6.723](https://doi.org/10.1161/01.str.12.6.723). PMID: 6272455.

- 80.** Liu XG, Branston NM, Kawauchi M, Symon L. A model of acute focal ischemia in the territory of the anterior cerebral artery in baboons. *Stroke*. 1992 Jan;23(1):40-4. doi: [10.1161/01.str.23.1.40](https://doi.org/10.1161/01.str.23.1.40). PMID: 1731419.

Building on this understanding, a 1987 paper on recovery of brain function after ischaemia describes a case series of reversible ischaemia and neurological recovery, highlighting the role of early reperfusion in achieving restoration of function.

- 81.** Symon L. Recovery of brain function after ischaemia. *Acta Neurochir Suppl (Wien)*. 1987;41:97-103. doi: [10.1007/978-3-7091-8945-0_13](https://doi.org/10.1007/978-3-7091-8945-0_13). PMID: 3481943.

Lindsay Symon made many other significant contributions from his extensive surgical practice, amongst them an incredible personal series on the natural history of cerebral arteriovenous malformations, which remains amongst the best documented. This study of 129 AVMs describes the natural history (3.6% mortality rate from haemorrhage) and surgical outcomes (1.5% mortality, 8.7% major morbidity), serving as a benchmark for modern series.

- 82.** Davis C, Symon L. The management of cerebral arteriovenous malformations. *Acta Neurochir (Wien)*. 1985;74(1-2):4-11. doi: [10.1007/BF01413268](https://doi.org/10.1007/BF01413268). PMID: 3976444.

Cortical spreading ischaemia is a process involved in ischaemic damage in patients with aneurysmal subarachnoid haemorrhage. This translational study by Dreier and colleagues established proof of cortical spreading depolarisations as a novel pathophysiological mechanism of disease and potential target for neuroprotective intervention in the human brain, particularly as an effect of subarachnoid haemorrhage. Imaging the spreading suppression offered a promising tool to differentiate between progressive ischaemic damage and repair phases in the human brain non-invasively.

- 83.** Dreier JP, Major S, Manning A, Woitzik J, et al; COSBID study group. Cortical spreading ischaemia is a novel process involved in ischaemic damage in patients with aneurysmal subarachnoid haemorrhage. *Brain*. 2009 Jul;132(Pt 7):1866-81. doi: [10.1093/brain/awp102](https://doi.org/10.1093/brain/awp102). Epub 2009 May 6. PMID: 19420089; PMCID: PMC2702835.

Managing the delayed ischaemic effects of aneurysmal rupture has exercised neurosurgeons over the decades. Ameen and Illingworth investigated the antifibrinolytic treatment epsilonaminocaproic acid in 100 consecutive patients prior to surgery to reduce rebleeding, but found that this increased the risk cerebral ischaemia. There was no improvement in outcome, and this important study contributed to the discontinuation of its use.

- 84.** Ameen AA, Illingworth R. Anti-fibrinolytic treatment in the pre-operative management of subarachnoid haemorrhage caused by ruptured intracranial aneurysm. *J Neurol Neurosurg Psychiatry*. 1981 Mar;44(3):220-6. doi: [10.1136/jnnp.44.3.220](https://doi.org/10.1136/jnnp.44.3.220). PMID: 7229645; PMCID: PMC490895.

Several years later, a randomised controlled trial of 479 patients demonstrated that tranexamic acid (TXA) reduced the rate of rebleeding from 24% to 9%, but that there was again an increase in ischaemic complications (from 15% in the control group to 24% in the TXA group). TXA had no overall benefit to patients.

- 85.** Vermeulen M, Lindsay KW, Murray GD, Cheah F, et al. Antifibrinolytic treatment in subarachnoid hemorrhage. *N Engl J Med*. 1984 Aug 16;311(7):432-7. doi: [10.1056/NEJM198408163110703](https://doi.org/10.1056/NEJM198408163110703). PMID: 6379455.

The first randomised double blind trial performed at four British neurosurgical centres studied the effect of oral nimodipine on cerebral infarction and outcome after subarachnoid haemorrhage. The British aneurysm nimodipine trial was a landmark, demonstrating that nimodipine reduced the incidence of cerebral ischaemia by 44%, and poor outcome by 40%. Nimodipine remains a critical part of current neurosurgical practice.

- 86.** Pickard JD, Murray GD, Illingworth R, Shaw MD, et al. Effect of oral nimodipine on cerebral infarction and outcome after subarachnoid haemorrhage: British aneurysm nimodipine trial. *BMJ*. 1989 Mar 11;298(6674):636-42. doi: [10.1136/bmj.298.6674.636](https://doi.org/10.1136/bmj.298.6674.636). PMID: 2496789; PMCID: PMC1835889.

STASH, a large international randomised trial, compared simvastatin to placebo in aneurysmal subarachnoid haemorrhage, and demonstrated the ability of UK neurosurgery to run a CTIMP (Clinical Trial of Investigational Medicinal Product) with international sites. Simvastatin did not significantly reduce poor functional outcome or mortality compared with placebo, and its routine use is not recommended.

- 87.** Kirkpatrick PJ, Turner CL, Smith C, Hutchinson PJ, Murray GD; STASH Collaborators. Simvastatin in aneurysmal subarachnoid haemorrhage (STASH): a multicentre randomised phase 3 trial. *Lancet Neurol*. 2014 Jul;13(7):666-75. doi: [10.1016/S1474-4422\(14\)70084-5](https://doi.org/10.1016/S1474-4422(14)70084-5). Epub 2014 May 15. PMID: 24837690.

Neurosurgeons have led innovation in stereotactic radiosurgery for management of arteriovenous malformations. The stereotactic radiosurgery unit in Sheffield became operational in September 1985 and this 1989 paper reported an analysis of 52 cases. No immediate morbidity or late side effects were encountered in these patients, setting the scene for the units continued leadership in this field.

- 88.** Kemeny AA, Dias PS, Forster DM. Results of stereotactic radiosurgery of arteriovenous malformations: an analysis of 52 cases. *J Neurol Neurosurg Psychiatry*. 1989 May;52(5):554-8. doi: [10.1136/jnnp.52.5.554](https://doi.org/10.1136/jnnp.52.5.554). PMID: 2659735; PMCID: PMC1032159.

Whether early surgery is preferable to initial conservative treatment in patients with spontaneous supratentorial intracerebral hematomas has vexed neurosurgeons for generations. In the Surgical Trial in Intracerebral Haemorrhage (STICH) study, Mendelow and colleagues sought to address this question, and later focused on supratentorial lobar intracerebral haematomas in STICH II. These studies of non-aneurysmal intracerebral haematomas showed a trend towards a small benefit from early surgery, which was not statistically significant. Subsequent meta-analysis of related trials have suggested a possible benefit of surgery,

but with a relatively large Number Needed to Treat (NNT) to obtain one favourable outcome (NNT from meta-analysis of between 8 and 17).

89. Mendelow AD, Gregson BA, Fernandes HM, Murray GD, et al.; STICH investigators. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. *Lancet*. 2005 Jan 29-Feb 4;365(9457):387-97. doi: [10.1016/S0140-6736\(05\)17826-X](https://doi.org/10.1016/S0140-6736(05)17826-X). PMID: 15680453.
90. Mendelow AD, Gregson BA, Rowan EN, Murray GD, et al.; STICH II Investigators. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial. *Lancet*. 2013 Aug 3;382(9890):397-408. doi: [10.1016/S0140-6736\(13\)60986-1](https://doi.org/10.1016/S0140-6736(13)60986-1). Epub 2013 May 29. Erratum in: *Lancet*. 2013 Aug 3;382(9890):396. Erratum in: *Lancet*. 2021 Sep 18;398(10305):1042. doi: [10.1016/S0140-6736\(21\)02012-2](https://doi.org/10.1016/S0140-6736(21)02012-2). PMID: 23726393; PMCID: PMC3906609.

Preclinical and translational science

British neurosurgeons have made significant contributions to preclinical science, including experimental work in cerebral blood flow, neuroprotection, traumatic brain injury, hydrocephalus, brain tumours and cerebrovascular disease, often through close collaboration with neuroscientists, engineers and other basic scientists. The investigation of disease mechanisms, and development of novel surgical technologies and pharmacological strategies, has led to subsequent clinical trials, demonstrating how preclinical research can inform surgical practice and improve patient outcomes.

Diana Beck (1902 - 1956) published widely during her tragically short career. Following neurosurgical training in Oxford under Hugh Cairns, she collaborated with pathologist Dorothy Russell. By 1945, the outcome of war wounds, including head wounds was much improved by the advent of antibiotics. Cairns had published 'Penicillin in Head and Spinal Wounds' following the experiences of the British Army mobile neurosurgical units in Sicily and the rest of Italy. However, those with a successful head wound closure were often left with a disfiguring skull defect. This paper from Beck is an early assessment of an alternative material to iliac crest graft, using an animal model. Acrylic plastic was, and still is, used for dental reconstruction. Malcolm Graham, the senior author of the paper, was an Oxford dental surgeon. He continued to develop cranial reconstruction in Oxford with Walpole Sinclair Lewin who would later become a consultant in Cambridge. Diana Beck would probably not have considered this her seminal paper, but it illustrates the importance of collaboration. None of the authors would have anticipated the widespread application of cranioplasty today and the ongoing investment, research and debate regarding the ideal material.

91. Beck, D.J.K., Russell, D.S., Small, J.M. and Graham, M.P. (1945), Implantation of acrylic-resin discs in rabbits' skulls. *Br J Surg*, 33: 83-86. <https://doi.org/10.1002/bjs.18003312913>

In a 1975 study from Lindsay Symon and colleagues, measurement of regional cerebral blood flow (CBF) was made using intracarotid xenon 133 in 24 patients with "multi-infarct" or "primary degenerative" dementia. Both groups had reduced brain volume, but the CBF per 100 gm brain per minute was normal in the primary degenerative group and low in the multi-infarct group. This suggested blood flow is adequate for metabolic needs of the brain in patients with primary degenerative dementia but inadequate for those with multi-infarct dementia, transforming understanding of the pathology.

92. Hachinski VC, Iliff LD, Zilhka E, Du Boulay GH, et al. Cerebral blood flow in dementia. *Arch Neurol*. 1975 Sep;32(9):632-7. doi: [10.1001/archneur.1975.00490510088009](https://doi.org/10.1001/archneur.1975.00490510088009). PMID: 1164215.

The preclinical and translational science underpinning modern immune therapies for glioma has been developing for decades. Early strategies used conventional antibodies in an attempt to produce specific neural markers, but they generally were unable to discriminate satisfactorily between neuronal subpopulations. In this 1980s study a monoclonal antibody was described which recognised a functionally discrete neuronal population in the vertebrate brain. Over the next decade the team then adopted this pioneering technique using monoclonal antibodies to start to treat malignant gliomas by a single intracavity injection of 131I monoclonal antibody. This served as early pioneering work on use of immunotherapy in malignant brain tumours.

93. Garson JA, Beverley PC, Coakham HB, Harper EI. Monoclonal antibodies against human T lymphocytes label Purkinje neurones of many species. *Nature*. 1982 Jul 22;298(5872):375-7. doi: [10.1038/298375a0](https://doi.org/10.1038/298375a0). PMID: 6178042.

94. Papanastassiou V, Pizer BL, Coakham HB, Bullimore J, Zananiri T, Kemshead JT. Treatment of recurrent and cystic malignant gliomas by a single intracavity injection of ¹³¹I monoclonal antibody: feasibility, pharmacokinetics and dosimetry. *Br J Cancer*. 1993 Jan;67(1):144-51).

The unique ascertainment of NF2 cases in the North West of England led to the publication of a landmark paper on the prevalence of NF2, figures which remain accurate and are regularly cited more than 30 years later. The study of 150 patients confirmed that NF2 is an autosomal dominant disorder, with an estimated incidence of 1 in 33,000–40,000. Around 49% of cases resulted from new mutations. Importantly, the authors found evidence of a maternal transmission effect, with maternally inherited NF2 presenting at a younger age than paternally inherited disease. It also highlighted that NF2 may comprise different clinical subtypes ranging from later-onset disease with bilateral vestibular schwannomas to earlier-onset, more tumour-heavy disease.

95. Evans DG, Huson SM, Donnai D, Neary W, et al. A genetic study of type 2 neurofibromatosis in the United Kingdom. I. Prevalence, mutation rate, fitness, and confirmation of maternal transmission effect on severity. *J Med Genet*. 1992 Dec;29(12):841-6. doi: [10.1136/jmg.29.12.841](https://doi.org/10.1136/jmg.29.12.841). PMID: 1479598; PMCID: PMC1016198.

From the same group, analysis of three unrelated individuals with familial multiple spinal meningiomas, without NF2 mutations, detected a loss-of-function mutation in the gene SMARCE1. This was the first description of this inherited disorder leading to the development of multiple meningiomas.

96. Smith MJ, O'Sullivan J, Bhaskar SS, Hadfield KD, et al. Loss-of-function mutations in SMARCE1 cause an inherited disorder of multiple spinal meningiomas. *Nat Genet*. 2013 Mar;45(3):295-8. doi: [10.1038/ng.2552](https://doi.org/10.1038/ng.2552). Epub 2013 Feb 3. PMID: 23377182.

A 2008 study from Wilson and Milledge documented pioneering work on high-altitude ICP physiology. The "tight-fit" hypothesis of acute mountain sickness is that individuals with less compliant cerebrospinal fluid systems (smaller ventricles and cerebrospinal fluid spaces) have a greater increase in intracranial pressure (ICP) for a given increase in brain volume, because of hypoxic cerebral oedema. There had previously only been 1 study of direct (telemetric) ICP measurement at high altitude, performed in 1985 on 3 subjects up to a maximum height of 16,500 ft (5030 m). Wilson and Milledge's unique research, unlikely to ever be repeated, is the only report of direct ICP measurement at high altitude. This and the computed tomographic study provide the first objective evidence supporting the "tight-fit" hypothesis of acute mountain sickness.

97. Wilson MH, Milledge J. Direct measurement of intracranial pressure at high altitude and correlation of ventricular size with acute mountain sickness: Brian Cummins' results from the 1985 Kishtwar expedition. *Neurosurgery*. 2008 Nov;63(5):970-4; discussion 974-5. doi: [10.1227/01.NEU.0000327885.15132.CA](https://doi.org/10.1227/01.NEU.0000327885.15132.CA). PMID: 19005388.

Neil-Dwyer made many important contributions to the study of cerebral aneurysms and subarachnoid haemorrhage. This study examined collagen in skin and temporal artery biopsies from 17 patients with ruptured cerebral aneurysms, comparing them with six age- and sex-matched controls. Eleven of the patients had a deficiency of type III collagen, whereas all controls had normal collagen ratios. The authors suggested type III collagen deficiency may contribute to arterial wall weakness and susceptibility to cerebral aneurysm rupture, drawing parallels with the vascular form of Ehlers-Danlos syndrome.

98. Neil-Dwyer G, Bartlett JR, Nicholls AC, Narcisi P, Pope FM. Collagen deficiency and ruptured cerebral aneurysms. A clinical and biochemical study. *J Neurosurg*. 1983 Jul;59(1):16-20. doi: [10.3171/jns.1983.59.1.0016](https://doi.org/10.3171/jns.1983.59.1.0016). PMID: 6864273.

In 1991, Gill and colleagues in Queen Square described a non-invasive head fixation system, accurately relocatable, which enabled the transfer of stereotactic positions between a variety of radio diagnostic images and therapeutic procedures. This was a key step in the evolution of frameless neuronavigation.

99. Gill SS, Thomas DG, Warrington AP, Brada M. Relocatable frame for stereotactic external beam radiotherapy. *Int J Radiat Oncol Biol Phys.* 1991 Mar;20(3):599-603. doi: [10.1016/0360-3016\(91\)90076-g](https://doi.org/10.1016/0360-3016(91)90076-g). PMID: 1995547.

In 2006, John Pickard and colleagues in Cambridge used functional magnetic resonance imaging to demonstrate preserved conscious awareness in a patient fulfilling the criteria for a diagnosis of vegetative state. When asked to imagine playing tennis or moving around her home, the patient activated predicted cortical areas in a manner indistinguishable from that of healthy volunteers. This was a landmark paper identifying patients in the vegetative state who, nevertheless, could perform complex mental imagery - covert cognition or cognitive motor dissociation.

100. Owen AM, Coleman MR, Boly M, Davis MH, Laureys S, Pickard JD. Detecting awareness in the vegetative state. *Science.* 2006 Sep 8;313(5792):1402. doi: [10.1126/science.1130197](https://doi.org/10.1126/science.1130197). PMID: 16959998.