Editorial

Personal considerations on the history of microneurosurgery

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The intention of Dr. Link et al.\textsuperscript{50} to illuminate Dr. R. M. P. Donaghy as a “genuine role model” for the young and coming generations of neurosurgeons is a great idea that I wish to wholeheartedly support.

The endeavors of Dr. Donaghy in the field of microvascular surgery have been appreciated in numerous previous publications. At the Cerebrovascular Section of the American Association of Neurological Surgeons Meeting in New Orleans, Louisiana, in April 1991, I was honored to give the first Donaghy Lecture, in which I underlined his scientific and clinical contributions as well as his strong personality.

The authors have assured the editor of the *Journal of Neurosurgery* that their paper was created using accurate, previously published, or other written accounts. This strong assertion must be challenged, however, because several previous publications dealing with the history of microneurosurgery have not been considered.\textsuperscript{15,24,26,28,32–50,61,79,92,115–117,128}

I am deeply grateful to Dr. John A. Jane Sr., who has given me the opportunity in this editorial to comment on the 50-year history of microneurosurgery, which I personally experienced and witnessed. I also wish to explain the relationship with my esteemed teacher Dr. R. M. P. Donaghy, who introduced me to microsurgical techniques on the small extracranial vessels of animals and provided me with laboratory facilities, his full support, and total freedom to develop microtechniques for microsurgery of the brain arteries in mongrel dogs.\textsuperscript{15,114,128}

Microscopes and Operating Microscopes

The authors mention Saemisch, who had introduced compound lens magnification to medicine in 1876. In one of my publications\textsuperscript{54} as well as those of Donaghy,\textsuperscript{20,24} and Kriss and Kriss,\textsuperscript{22} this topic has been discussed at length, and large numbers of references are provided. Credit should be given to Giuseppe Campani (1635–1715) in Bologna, Italy, who invented the screw-barrel type optical viewing system, which could be used as both a telescope and microscope.\textsuperscript{116} In a letter to the Pope dated June 15, 1686, Campani, referring to his drawing, wrote: “the illustration shows the application of the microscope to the examination of the wound of the leg.” This inci-

dent should be declared the first practical use of a microscope in medicine and surgery (see Fig. 6.1, page 109\textsuperscript{116}). Campani’s vision would require additional advances in technology and science, a process that successively progressed for 200 years and was finally perfected by E. Abbe,\textsuperscript{1} K. Zeiss, and O. Schott in Jena, Germany, during the final decades of the 19th century. Thirty-five years later, Dr. Nylen of Stockholm, Sweden, pioneered microsurgery in otology by using a simple monoscope,\textsuperscript{74,75} which was steadily improved in the following 4 decades by otologists and eye surgeons.

In 1952 Dr. H. Littmann (Zeiss-Oberkochen) succeeded in modifying the initial coloscope of Hinselmann into a sophisticated, maneuverable microscope for surgical requirements, which was known as the OPMI-1.\textsuperscript{61} The magnification could be changed without altering the focal length, and the object was always in sharp focus. The distance of 16 mm between the inner lenses enabled the surgeon to view the field stereoscopically through a narrow opening. The OPMI-1 was exhibited at the 5th International Congress of Otolaryngologists in Amsterdam, Holland, in 1953. This microscope, with its coaxial light system, was adaptable for various types of surgery and thus drew the attention not only of otological surgeons, but also ophthalmological surgeons and neurosurgeons.

Professor H. L. Wullstein, chairman of the ear, nose, and throat (ENT) department in Würzburg, Germany, who in 1948–1949 had innovated an easily movable device consisting of a 10x Leitz magnifier mounted on the stand and swivel arm of a dental engine, was a valued advisor to Dr. Littman. With this instrument, Wullstein performed 1000 ENT operations until 1953.\textsuperscript{9,113} He was the teacher of Dr. W. House, who transferred ENT microsurgery technology to California. After observing the meticulous surgery of Dr. House in 1957,\textsuperscript{24–36} Dr. Ted Kurze envisioned the use of microtechniques in neurosurgery. He opened the world’s first cranial base microsurgery training laboratory and began to train himself before his first clinical surgery in the summer of 1957.\textsuperscript{74–89} In 1960, while working in the laboratory at the Mary Fletcher Hospital, University of Vermont, Burlington, Vermont, Dr. J. Jacobson (cardiovascular surgery) and his assistant Dr. E. Suarez borrowed the OPMI-I from the ENT department and attained superb results on microsurgical procedures on dog carotid arteries.\textsuperscript{26,37–40} In 1958 Dr. Jacobson and Dr. Donaghy established the world’s first microsurgical training laboratory, followed by a similar founding by J. Buncke in Palo Alto, California,\textsuperscript{4–9} W. M. Lougheed in Toronto, Canada,\textsuperscript{62–65} and J. R. Cobbett in London, United Kingdom.\textsuperscript{15}
The specific needs of the various surgical specialties as well as the individual disposition of surgeons incited continuous modification of the optic and mechanical systems of the microscope. Jacobson and Donaghy succeeded in convincing Dr. Littmann to invent for the OPMI-1 microscope an automatic focusing device and a beam splitter system for attaching a monocular observing tube and television or movie cameras. The lack of free and effortless mobility inherent to the initial surgical microscope was improved with the introduction of a counterbalanced “floating” microscope coupled with an electromagnetic braking system at various joints that provided absolute stability with good mobility. This braking system was invented and produced by Contraves in 1971 and the Studer Company in 1992, both in Zurich, Switzerland. My initial idea of an electronic senso-steering system for the operating microscope, a system similar to that used by airplane pilots, was later simplified by adopting the counter-balance idea put forward by Dr. Leonard Malis.21–22 The addition of a mouth switch allowed effortless movement of the microscope to focus, leaving the surgeon’s hands free to perform the surgical procedure. An electrical warming cable around the eyepieces eliminated the annoying fogging of the ocular lenses. In 1986, my concept of a video system that enabled colleagues to follow the surgical procedures on a 3D monitor was developed and produced by R. Fabian in St. Louis, Missouri (Table 1).

Instruments for Microneurosurgery

Dr. Link and colleagues credit Dr. Donaghy and his guidance with the success of microvascular neurosurgery and the development of micro-T-tubes, finer instruments, sutures, and needles. This equipment is sufficient for laboratory work.20,73 However, the specific instruments and equipment for clinical microneurosurgery were independently developed in Zurich between 1967 and 1993. The counterbalanced floating operating microscope, fish-hooks for the skin and muscle flaps, dural dissectors, set of 32 bayonet forceps in different lengths and tip-sizes for bipolar coagulation, microscissors, microrongeurs, vascular clips, aneurysm clips, microclips for the small feeding arteries of arteriovenous malformations (AVMs), mobile tip mirrors, hydraulic armrest, surgeon’s stool, and nurse’s instrument table were envisioned, invented, and produced in Zurich and Tuttingen (Table 2).116,122,128,136

Microsutures and needles were developed by Dr. Buncke in California and later by Springer and Tritt in Tuttingen. For the microinstruments developed by Dr. Leonard Malis, refer to his publications.67–72

Brain Revascularization

The revascularization of the brain in cases of stroke probably occurred to colleagues many decades ago, which places emphasis on the urgent needs of patients. The so-called encephalomyosynangiosis was pioneered by neurosurgeons: by W. I. German and A. Taffel in animals in 1939, by E. Kredel in 1942 in humans in the US,21 and by Professor Henschel, general surgeon, of Basel, Switzerland, in humans in 1942.22 As a medical student I listened to the latter’s stimulating ideas on surgery, but I do not remember this particular procedure. Applying temporal muscle over the exposed brain is a routine method for revascularization of the brain, at least in cases of moyamoya disease.

The first EC-IC vascular bypass was performed in 1962 by E. Woring (neurosurgeon in Colmar, France) and J. Kunlin (vascular surgeon in Paris, France).112 The 63-year-old male patient, with occlusion of the left internal carotid artery (ICA), received a bypass graft taken from the saphenous vein. Anesthesia was induced and surgery was conducted under hypothermic conditions. The graft was inserted using a very unusual approach between the common carotid artery and the intracranial artery. The patient survived this long procedure, regained consciousness, but later died of a pneumonia complication. This heroic, pioneering achievement was described in 1963 in the journal Neurochirurgie (Paris). References for this original attempt of Woring and Kunlin are given in my former publications.116,122,128 Expanding on the original idea of Woring and Kunlin, in February 1966 I performed high-flow graft bypasses between the common carotid and basilar or middle cerebral arteries (MCAs) in dogs. However, within a short time, the arterial and venous grafts became thrombosed. I believed that the surgical manipulation on the vasa vasorum of the donor vessels may have caused the thrombosis, an assumption also made by Smith.14,92,108,109 I began to perform bypass procedures between the superficial temporal artery (STA) and the anterior branch of the MCA. These bypasses remained patent. Therefore, the idea to create such a bypass did not originate from cooperation between Dr. Donaghy and me, as Dr. Link and colleagues supposed.119 The concept of this particular bypass procedure arose spontaneously in the laboratory as a consequence of failed high-flow bypass procedures and the determination to find a substitute solution.

On October 30, 1967, I performed my first extracranial-intracranial (EC-IC) bypass procedure in a 20-year-old man with Marfan syndrome, who had suffered a stroke with right-sided hemisindrome and showed, on left-sided carotid artery angiography, occlusion of the M1 segment. His postoperative course was uneventful, but he and his parents refused a control angiography study. He survived some decades and had good palpable pulsation of the left STA (see Table XIII.128). Therefore, Dr. Link and colleagues’ assertion that my first patient to undergo a bypass procedure had a glioblastoma multiforme and died shortly after surgery is inaccurate. I would be interested to learn the source of their statement and hope other authors will not cite this error in the future.

My second patient, a 61-year-old man, experienced transient ischemic attacks by turning his head to the right side. Angiograms showed occlusion of the bilateral ICAs and the right vertebral artery (see Fig. 6a–h).22 As a hydrodynamics engineer, he immediately perceived the problem of the blood supply in his brain and agreed to undergo the proposed arterial bypass between the left STA and the anterior branch of the MCA. The surgery was successfully accomplished was on November 7, 1967. His postoperative course was uneventful. The postoperative left-sided carotid artery angiogram confirmed excellent