

The History of Radiosurgery in ...

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Focus external beam radiation to concentrate dose to a target and spare the peripheral structures appeared in the literature in 1906. It was described by Kohl only 18 years after the discovery of x-rays. During the following years the idea evolved with spiral converging beam; directed beam; and finally rigid hemispheric attached beam directed with stereotactic precision in 1951. It was Dr. Lars Leksell, a functional neurosurgeon at Karolinska University in Stockholm, who integrated the stereotactic precision with the penetrating capability and the radiobiological effect of the x-ray beam. The term "radiosurgery" was coined.

Radiosurgery evolved during the last half of the last century linked to the rapid development of imaging techniques. While dependent on ventriculography, cysternography and angiography, the applications of radiosurgery were largely limited to the pathologies visualized by these techniques. Ventriculography displayed the third ventricle structures used for functional targets located centrally in the brain. Meckel's cave contrast material injection and cysternography provided the targets for treatment of trigeminal neuralgia and acoustic neuroma respectively. Angiography provided the visualization of arteriovenous malformations (AVMs), making them the classic application of radiosurgery starting in 1972. The remarkable disappearance of these lesions after radiosurgery as detected by this imaging modality, and the surgical challenge AVMs pose to the neurosurgeon secured the importance of radiosurgery within neurosurgery. The build-up of radiosurgery applications with the introduction of structural diseases such as acoustic neuromas, AVMs and largely brain metastases increased the demand of affordable radiosurgery throughout the work. In the early 1980s three gamma units, Stockholm, Buenos Aires and Sheffield and few heavy particle beam facilities, prominently Berkeley and Boston provided the radiosurgery care for the world. Dr. Raymond Kjellberg, trained in Radiosurgery by Dr. Lars Leksell, returned to Boston from Stockholm and advanced the knowledge on particle beam radiosurgery, developing important concepts of radiosurgery dosimetry still used today.

Dr. Jack Fabrikant inherited the Berkeley heavy particle program, which was active since the early 1950's irradiating the pituitary gland. He made important advances to the radiosurgery applications, more specifically to AVMs. The highest prize of our society is named after him because of his forthrightness reporting the adverse effects of single dose radiation and his immense contribution to the field. Dr. Juan Luiz Barcia-Salorio in 1975 used a telecobalt machine to treat patients in Valencia, Spain, advancing the treatment of epilepsy with radiosurgery. The Karolinska University donated the first Gamma Knife entering the United States to the University of California in Los Angeles (UCLA) in 1983. At the same time, happened the first adaptation of a Linear Accelerator to radiosurgery by the Argentinian Dr. Osvaldo Betti. The era of modern radiosurgery was started with the wide availability of computer imaging and computer dosimetry. Integration of these two developments to Gamma Units and Linear Accelerators allowed worldwide progress of Radiosurgery, culminating with the need of a dedicated society in 1991 to serve as the scientific forum for practitioners of radiosurgery to convey their advances, since they represented a convergence of several established specialties in the medical field: Neurosurgeons, Radiation Oncologists and Medical Physics. The ISRS with its diverse fields of knowledge was formed.

During the modern era of Radiosurgery prominent centers using the Gamma Knife, starting with University of Pittsburgh in 1987, University of Tokyo 1988, University of Virginia 1989,

Mayo Clinic, Rochester 1990, and precisely adapted Linear accelerators in Vicenza, Italy 1984, Harvard University, Boston 1988, University of Florida, Gainesville 1989, University of California, Los Angeles 1990, rapidly accentuated valuable data on the efficacy and complications of Radiosurgery, making the technique acceptable to Neurosurgeons and Radiation Oncologists, previously using other means to treat the diseases which radiosurgery progressively showed to yield better results. These developments became the basis of the ISRS meetings throughout the 1990's, when cranial applications largely dominated the radiosurgery field.

A robotic miniature Linear accelerator radiosurgery, obviating the use of the stereotactic frame, was developed in California at Stanford University during this period. The device was created with the idea of advancing radiosurgery beyond the intracranial applications. In the mid 1990's three beta-sites were operational in the United States, the device became commercially available with the name of Cyberknife and is now worldwide used to treat diverse sites of the human body, expanding the scope of the ISRS society beyond the relationship between neurosurgeons and radiation oncologists. Our Society followed the developments, introducing sections on the treatment of lung, pancreas, prostate, liver and other important areas in Oncology. Dedicated traditional Linear accelerators were calibrated to precision and dosimetric improvements such as shaped beam, intensity modulation, as well as frameless capabilities more recently. The first of these devices appeared commercially available with the name of Novalis in 1996, helping to expand the scope and comfort for patients undergoing radiosurgery. Several other sorts for focus beam radiation have appeared during the last 20 years, they have gained their share of the market, their specific applications are being defined and will continue challenging the established devices, incorporating novel imaging and dosimetric developments, forging better results and comfort for patients with cancer and neurological disorders.