

The History of Radiosurgery in... *The Netherlands*

Stereotactic radiosurgery was introduced in the Netherlands in 1991 at VU University medical center in Amsterdam. Drs. Karim, radiation oncologist Wolbers, neurosurgeon, and Elsenaar, clinical physicist used a Varian Clinac 600 machine in combination with circular collimators to treat the first patient with a single brain metastasis. At that time, the radiosurgery project was partly funded by the Government in order to establish the technique in the country and to evaluate possible indications. During the first three years referral for radiosurgery was uncommon, and only approximately 30 patients, of which half with arteriovenous malformations (AVM) were treated. Initially, accepted indications for radiosurgery were AVM's, acoustic neurinomas and solitary brain metastases. All patients were discussed in a multidisciplinary radiosurgery meeting, and target contouring was performed jointly between radiation oncologists and neurosurgeons, whereas treatment planning was performed by a physicist. Single fraction radiosurgery (RS) was delivered using an invasive frame.

Following the clinical implementation of the non-invasive Gill-Thomas-Cosman frame with bite-block, fractionated radiosurgery and stereotactic radiotherapy became valid treatment options. Although initially only dentate patients with acoustic neurinomas were treated with fractionated stereotactic radiotherapy, patients with e.g. base of skull meningiomas were soon to follow. With increasing experience in the clinical use of the GTC frame, the same non-invasive patient fixation method was used for single fraction radiosurgery of brain metastases in non-critical locations.

In the initial years of radiosurgery, planning and delivery for a single fraction could easily take up to 10 hours with all involved physicians and physicists being present during most steps of the process. During the late 90's , RS and SRT became increasingly better integrated into routine clinical practice, and the number of new patients who were treated increased to 1-3 per week.

Many readers will still remember one of the first international conferences on RS and

SRT, organized by the department in Amsterdam in May 1993. A few years after the start at VUmc in Amsterdam, the Daniel den Hoed Cancer center in Rotterdam, was the second Dutch radiotherapy department to start a clinical radiosurgery program. A few years later, in 2002, neurosurgeons together with the radiotherapy colleagues in Tilburg, treated the first patients on a Gammaknife. Departments of Radiation Oncology at the Universities of Maastricht and Groningen started stereotactic treatments using modified linear accelerators. In recent years, more centers have started intracranial RS/SRT, but most of them focus on brain metastases and still commonly refer patients with benign indications to one of the more experienced centers. One other recent development has to be highlighted; the implementation of frameless radiosurgery and stereotactic radiotherapy. The use of high-precision custom-made masks in combination with several options for image-guidance on the linear accelerator has basically made the use of stereotactic frames obsolete. The accuracy of modern frameless positioning systems has been reported to be well within 1 mm, and has now become standard for the vast majority of patients treated in The Netherlands.

As in other countries, the success of radiosurgery for intracranial lesions has prompted interest in the use of similar techniques for extracranial lesions. After the installation of a 4-dimensions (4D) CT scanner and a Novalis system with Exactrac in 2003 at VUmc, body stereotactic radiotherapy was introduced in the Netherlands. Shortly thereafter, Erasmus medical center in Rotterdam also started an SBRT program. Initially, the main indication for body stereotactic radiotherapy was stage I non-small cell lung cancer (NSCLC), in patients who either refused surgery, or who were deemed to be at high risk for surgery based on co-morbidity. Other indications for SBRT metastases in the lungs, liver, adrenal glands and spine; more general patients with oligometastases. The excellent outcomes of SBRT for early stage NSCLC have prompted other centers to start SBRT for stage I NSCLC as well. Currently, about half of the 21 radiotherapy centers in the Netherlands offer this approach.

Figure: Stereotactic radiotherapy using cones (VU Amsterdam, 1992)



Authors:

Ben J. Slotman and Frank J. Lagerwaard,

Dept. of Radiation Oncology,

VU University medical center,

Amsterdam, The Netherlands

Bj.slotman@vumc.nl