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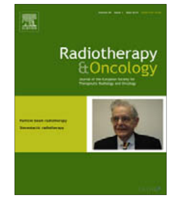


Radiosurgery in Canada

# Radiosurgery scope of practice in Canada: A report of the Canadian association of radiation oncology (CARO) radiosurgery advisory committee

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ABSTRACT

Radiosurgery has a long history in Canada. Since the treatment of the first patient at the McGill University Health Center in 1985, radiosurgery programs have been developed from coast to coast. These have included multidisciplinary teams of radiation oncologists, neurosurgeons, medical physicists, radiation technologists and other health professionals.

In 2008, the CARO Board of Directors requested that a working group be formed to define the role of the radiation oncologist in the practice of radiosurgery. Taking into account evolving technology, changing clinical practice and current scope of practice literature, the working group made recommendations as to the role of the radiation oncologists. These recommendations were endorsed by the Canadian Association of Radiation Oncology board of directors in September 2009 and are present herein. It is recognized that patients benefit from a team approach to their care but it is recommended that qualified radiation oncologists be involved in radiosurgery delivery from patient consultation to follow-up. In addition, radiation oncologists should continue to be involved in the administrative aspects of radiosurgery programs, from equipment selection to ongoing quality assurance/quality improvement.
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In 2008, the CARO Board of Directors requested that a working group be formed to define the role of the radiation oncologist in the practice of radiosurgery (RS). This statement follows a 2004 document defining the scope of practice of radiation oncologists in Canada and a 2006 American College of Radiology/American Society for Therapeutic Radiology and Oncology (ASTRO) guideline for the practice of RS.

RS has a long history dating back to the 1940s when Dr. Lars Leksell designed an initial application based on kilovoltage X-rays. In 1954, the first in a long series of patients were treated with charged particles, many of these patients were women treated with pituitary ablation in the management of metastatic breast cancer. A decade later this was followed by treatment via dedicated cobalt units using a large number of crossfiring sources [1]. In the 1980s, RS became more widely available with the use of modified linear accelerators [2,3] and is now widespread in oncology centers around the world.

From the 1940s to the 1980s, the differences between radiosurgery and conventional radiation treatments were striking. In the years since, rapid evolutions in standard radiotherapy units and dedicated radiosurgery accelerators have blurred the line between conventional and stereotactic radiation. In many cases, this has freed clinicians from the previous forced choice between precise single fraction treatments and non-selective fractionated treatments [4,5]. Most recently, image-guidance systems have, in some cases, eliminated the surgical act of frame placement and erased the last remaining differences between single fraction and fractionated delivery.

Since its inception, RS has been applied to a number of benign and malignant intracranial tumors. In certain cases, RS is meant to exploit the biology of a large single fraction (for example, RS for vascular malformations), and in others the use of a single fraction is a convenient way to provide high-dose radiation in a timely manner for patients in a palliative setting (brain metastases). Although cranial RS is most commonly used for oncological

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applications, it has been used for a variety of other pathologies beyond traditional vascular indications, including pain syndromes [6,7], opthalmological diseases [8,9] and movement disorders [10,11].

For the purpose of this document, RS is defined as the precise application of a single, high dose of radiation to a small intracranial target. The application of multiple fractions to the same target in order to exploit the traditional radiobiology of radiotherapy is not, in the opinion of the workgroup, RS. This is consistent with the 2002 report of the American Society or Radiology and Oncology working group on scope of practice [12]. However, the staged single fraction treatment of different subvolumes of a large target would fall under the scope of RS. Treatment of extra-cranial lesions was specifically excluded from the scope/mandate of this report.

## Introduction

Primarily, the purpose of this document is to initiate a discussion of how our specialty can meet the needs and interests of RS patients, safely, efficiently, and competently. It is the prerogative of CARO to undertake this process independently in order to allow the specialty to ready itself for the continued evolution of the practice of RS. Scopes of practice determinations have been of use to stakeholders such as CARO in discussing with government, cancer care organizations and regulatory bodies the role of the specialty.

There is extensive literature on the notion of scope of practice. Much of the literature focuses on scope of practice of physicians and nurses; however, it is clear that there are many other professional groups that have overlapping scopes of practice. The definition for scope of practice is "...the activities for which the professional is educated, and authorized to perform; and is influenced by the setting in which the professional practices, the requirements of care delivery organizations, the needs of the patients or clients" [13]. Thus the notion of scope of practice reflects essentially the practice of the profession and is used as a guide to the profession and public.

### *Past and present – radiosurgery in Canada*

Cobalt radiotherapy was first introduced in Canada in the 1950s and inspired the design of the first Leksell–Larsson Gamma Knife based on these more penetrating rays. Although the first commercially developed Gamma Knife, the model U, was only produced in 1987, 1985 saw the development at McGill of a new Linac-based radiosurgery technique. The impetus for this development came from Dr. André Olivier, neurosurgeon at the Montreal Neurological Hospital. With the help of a team of physicists (Drs. Podgorsak, Peters, Pla, Olivares and Pike), Dr. Hazel – radiation oncologist, technicians and an electronics engineer, an initial patient was treated with a coplanar technique before the now well-known dynamic stereotactic technique was implemented in 1986.

The 1990s saw other centers implement the Montreal radiosurgery planning system and dynamic technique. First in Toronto, following the interest of Dr. Schwartz and then in London. The first patient treated in London underwent radiosurgery in February 1991. At the time, this was done using a modified LINAC with a floor mounted stand. Patients treated were at the time were primarily those with recurrent glioma, AVM and brain metastases. With improvements in couch design and stability, in 1997, the London technique was moved to a couch mounted system.

In the following years, other radiosurgery programs were created across Canada using commercial systems for the planning and delivery of treatment with modified linear accelerators. As an example, in 1997, the British Columbia Cancer Agency's provincial stereotactic radiosurgery program began operation in Vancouver using a commercial cone-based system.

Although, as early as 1987 patients were treated in Montreal with 6 fractions over 2 weeks, the use of hypofractionation remained uncommon at a time where invasive fixation was required.

Following the era of cone-based techniques on modified linear accelerators, in 1999, the first of many Canadian micro-multileaf (mMLC) collimators was installed in Toronto to be used with single fraction RS cases and fractionated stereotactic radiotherapy cases. Although in the year 2000 both mMLC and cone-base techniques co-existed in Montreal and Toronto, the London technique using invasive frames with custom circular collimators was decommissioned in favor of a non-invasive technique using an mask immobilization system, portal imaging and real-time optical guidance combined with a dynamic arc technique using a multileaf collimator. In 2002 treatment with RS began in Halifax at the Nova Scotia Cancer Centre. The program is run jointly by neurosurgery and radiation oncology and utilizes a linear accelerator with micro-multileaf collimators and a dedicated planning system. In 2004, a helical tomotherapy unit was installed in London and this has increasingly become the platform for image-guided SRT for brain metastases, selected recurrent glioma and "benign" tumors such as meningioma and acoustic neuroma. The Alberta radiosurgery program had used a cone-based system for 3 years when it installed the first Canadian commercially dedicated radiosurgery LINAC in 2004. This BrainLab Novalis remains in service to this day.

In 2003, the Winnipeg Regional Health Authority commissioned the installation of Canada's first Gamma Knife, a Model C with APS, at the Health Sciences Centre in Winnipeg. In 2004, the second Canadian Gamma Knife unit was installed at the Centre Hospitalier de l'Université de Sherbrooke. In 2005, the University Health Network opened the 3rd Canadian Gamma Knife unit as a joint collaboration between the Radiation Medicine Program, Princess Margaret Hospital, and the Krembil Neuroscience Center based at Toronto Western Hospital. This program was funded as a provincial resource for the delivery of radiosurgery for benign neurosurgical disorders including benign tumors, AVMs, as well as functional neurosurgical applications in pain syndromes, movement disorders, and epilepsy. In 2007, Princess Margaret hospital received the 4th Gamma Knife unit in Canada, and migrated their cancer radiosurgery program from linear accelerator systems to this new platform. In 2009, the Princess Margaret Gamma Knife Perfexion was first used for fractionated delivery with a relocatable frame.

In what may be the beginning of a fourth wave of Canadian RS systems, following a dedicated pedestal-based system and a tertiary micro MLC collimation system, le Centre Hospitalier de l'Université De Montréal accepted delivery in 2009 of the first Canadian CyberKnife frameless RS system. The first patient treatment on this robotic radiosurgery unit was delivered in June 2009. Another stereoscopic image-guided robotic device, the Novalis Tx, will replace the mMLC and cone-based programs at McGill in 2010.

Current practice in Canada has followed the technology used for the delivery of RS. Programs based on Gamma Knife technology tend to have a stronger neurosurgical involvement. Programs built around a dedicated or modified linear accelerator tend to be located in radiotherapy departments. Treatments delivered without the use of invasive immobilization and fractionated stereotactic radiotherapy (FSRT) are almost always delivered under the exclusive supervision of radiation oncologists while frame-based treatment are either supervised by a radiation oncologist or delivered jointly with neurosurgery.

### *Scope of practice*

Many health care tasks overlap between professions. Formal discussions about inter-professional roles and responsibilities

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