Ontario Health
Cancer Care Ontario

Guideline 21-6

A Quality Initiative of the Program in Evidence-Based Care (PEBC), Ontario Health (Cancer Care Ontario)

Consensus-based organizational guideline for the planning and delivery of spine stereotactic body radiotherapy treatment in Ontario

A. Sahgal, S. Kellett, T. Nguyen, P. Maralani, J. Greenspoon, K. Linden, A. Pearce, F. Siddiqi, M. Ruschin and the SBRT for Spine Expert Panel

Report Date: April 21, 2023

An assessment conducted in December 2025 deferred the review of Guideline 21-6. This means that the document remains current until it is assessed again next year. The PEBC has a formal and standardized process to ensure the currency of each document (PEBC Assessment & Review Protocol)

Guideline 21-6 is comprised of 5 sections. You can access the summary and full report here:
https://www.cancercareontario.ca/en/guidelines-advice/types-of-cancer/74056

For information about this document, please contact Dr. Arjun Sahgal, lead author, through the PEBC at:
Phone: 905-527-4322 ext. 42822 Fax: 905-526-6775 E-mail: ccopgi@mcmaster.ca

For information about the PEBC and the most current version of all reports, please visit the OH (CCO) website at https://www.cancercareontario.ca/en/guidelines-advice or contact the PEBC office at:
Phone: 905-527-4322 ext. 42822 Fax: 905-526-6775 E-mail: ccopgi@mcmaster.ca

PEBC Report Citation (Vancouver Style): A. Sahgal, S. Kellett, T. Nguyen, P. Maralani, J. Greenspoon, K. Linden, A. Pearce, F. Siddiqi, M. Ruschin and the SBRT for Spine Expert Panel. Organizational guideline for planning and delivery of spine stereotactic body radiotherapy treatment in Ontario Toronto (ON): Ontario Health (Cancer Care Ontario); *2023 April 21*. Program in Evidence-Based Care Guideline No.: 21-6.

PUBLICATIONS RELATED TO THIS REPORT

Sahgal A, Kellett S, Ruschin M, Greenspoon J, Follwell M, Sinclair J, Perry J, Islam O and the Stereotactic Radiosurgery for Brain Metastasis Guideline Development Group. Organizational Guideline for the Delivery of Stereotactic Radiosurgery for Brain Metastasis in Ontario. Toronto (ON): Cancer Care Ontario; 2019 August 27. Program in Evidence-Based Care Guideline No.: 21-4.

Copyright

This report is copyrighted by Ontario Health (Cancer Care Ontario); the report and the illustrations herein may not be reproduced without the express written permission of Ontario Health (Cancer Care Ontario). Ontario Health (Cancer Care Ontario) reserves the right at any time, and at its sole discretion, to change or revoke this authorization.

Disclaimer

Care has been taken in the preparation of the information contained in this report. Nevertheless, any person seeking to consult the report or apply its recommendations is expected to use independent medical judgment in the context of individual clinical circumstances or to seek out the supervision of a qualified clinician. Ontario Health (Cancer Care Ontario) makes no representations or guarantees of any kind whatsoever regarding the report content or its use or application and disclaims any responsibility for its use or application in any way

Consensus-based organizational guideline for the planning and delivery of spine stereotactic body radiotherapy treatment in Ontario

Recommendations

This section is a quick reference guide and provides the guideline recommendations only. For key evidence associated with each recommendation and implementation considerations, see the Full Report.

GUIDELINE OBJECTIVES

The objective of this organizational guideline is to ensure that cancer centres across Ontario have guidance as to how spine stereotactic body radiotherapy (SBRT) should be administered with the intent to minimize side effects and maximize patient safety. The administration of spine SBRT also includes the surveillance of SBRT patients post-SBRT, with both clinical and imaging follow-up practices as an essential practice for patient safety.

TARGET POPULATION

All cancer adult patients (>18) with spinal metastasis who are eligible to receive treatment with SBRT.

INTENDED USERS

Stakeholders include all Ontario Regional Cancer Programs that currently deliver, or planning spine SBRT. Specifically, in these Cancer Programs this guideline is intended for:

1. Clinicians involved in the organization and delivery of spine SBRT in Ontario.
2. Administrators involved in the organization and delivery of care of patients with spinal metastasis who are eligible for spine SBRT in Ontario.

RECOMMENDATIONS

Recommendation 1

The following medical professionals are recommended to be part of the multidisciplinary team evaluating patient eligibility and performing spine SBRT

- Radiation oncologist
- Spine surgeon
- Neuroradiologist
- Medical physicist
- Medical dosimetrist
- Radiation therapist

Qualifying Statements for Recommendation 1

- The clinical and imaging details of each spine SBRT case must be discussed in a multidisciplinary case conference (MCC) and local quality assurance (QA) procedures followed such that each plan is reviewed
- The MCC should ideally be comprised of a radiation oncologist, spine surgeon, medical oncologist, radiation therapist and neuroradiologist. It is recognized that not all centres

have access to a spine surgeon and, in this situation, having a spine SBRT fellowship-trained radiation oncologist lead the MCC and/or participate in a partner's institution MCC with access to the full composition of MCC members is strongly advised
- The members of the MCC listed above are in addition to the nurses and administrative staff who provide general support for all patients in the radiation oncology department.
- More information about MCCs is available from the Ontario Health (Cancer Care Ontario) (OH [CCO]) website included an MCC standards document and several guideline-based clinical tools (1)
- Treatment plan QA should be performed by the medical physicist in accordance with local procedures
- Contours and treatment plan reviewed in a QA rounds with radiation oncology, medical physics and radiation therapy present, and ideally prior to treatment delivery

Recommendation 2
The following training and/or certification requirements and responsibilities for members of the multidisciplinary team performing spine SBRT are recommended:

Radiation oncologist
- Qualifications
    - The radiation oncologist is accredited by a nationally or internationally recognized program or licensing board
    - Participation in a dedicated fellowship or course that provides technology-specific spine SBRT training is strongly recommended
    - Mentoring or training in a supervised setting within a spine SBRT program is strongly recommended
- Responsibilities:
    - Team leader, responsible for the selection of members of the spine SBRT team
    - Most responsible physician (MRP)
        - MRP refers to the physician who has overall responsibility for directing and coordinating the spine SBRT treatment and management of an individual patient at a specific point in time. The MRP will be responsible for the handover of care during periods of absence or transition of care to a different MRP and/or between treatment modalities. They will be the primary patient contact person during the duration of the treatment and will be responsible for communicating the harms and benefits of the spine SBRT treatment to patients
    - Oversee treatment of patient and sign off on treatment plan
    - Verification of target volume and normal tissues
    - Oversee patient positioning and immobilization
    - Participate in the monitoring and follow-up of patients post-SBRT procedure

Spine surgeon
- Qualifications
    - The spine surgeon is accredited by a nationally or internationally recognized program or licensing board
    - Participation in a training course that provides spine SBRT training is strongly recommended

- Responsibilities:

- It is recognized that a spine surgeon may not be present at each spine SBRT centre within Ontario; however, participation in the treatment decision-making team through an MCC is strongly recommended
- In the case where surgical input on clinical decision making is not routinely possible at least one radiation oncologist must have subspecialty fellowship training in spine SBRT and lead that team

Neuroradiologist

- Qualifications
  - The neuroradiologist is accredited by a nationally or internationally recognized program or board
- Responsibilities:
  - Participation in the MCC
  - Participation in developing imaging protocols required for spine SBRT cases
  - Reviewing pre- and post-procedure imaging

Medical physicist

- Qualifications
  - The qualified medical physicist is certified by the Canadian College of Physicists in Medicine or an equivalent national or international certification agency
  - Considered beneficial if trained in a spine SBRT-specific setting (within an SBRT program or by a supervised vendor)
  - Highly beneficial to have dedicated magnetic resonance (MR) training for sequence optimization and QA procedures
- Responsibilities:
  - Being knowledgeable of all technical aspects of a spine SBRT program, which includes simulation, imaging, planning, equipment, treatment delivery, and verification of output calibration
  - Development of the technical QA program including continual monitoring and associated documentation
  - Working with the radiation oncologists, radiation therapists, and medical dosimetrists to develop the optimal application of spine SBRT and treatment plan for a given patient
  - Being available for consultation for patient set-up and treatment delivery on the day(s) of the treatment
  - Participating in the peer review QA process
  - Being knowledgeable of the radiation safety procedures
  - Ensure members of the spine SBRT team have the necessary training to ensure the safe operation of the spine SBRT program
  - Working with the information technology staff to ensure network connectivity and data backup procedures are in place
  - Being aware of all sources of uncertainty in spine SBRT, including mechanical and dosimetric, and be able to provide mitigation strategies
  - Participating in continuing education activities to maintain expertise and awareness of best practices and guidelines
  - Note: In some centres, the medical physicist may also be responsible for spine SBRT planning

Medical dosimetrist

- Qualifications:
    - Medical Radiation Technologist - Radiation Therapist [MRT(T)] graduate of a recognized radiation therapy program with registration with the appropriate provincial college
    - Considered beneficial if trained in an SBRT-specific setting (within an SBRT program or by a supervised vendor)
    - Considered beneficial if experienced in treatment planning
- Responsibilities of the medical dosimetrist must be clearly defined and may include the following:
    - Working with the radiation oncologist and medical physicist in developing an effective SBRT treatment plan for the patient
    - Ensuring all relevant volumetric patient image data are included in the treatment planning system (TPS)
    - Generate all appropriate technical documentation required to implement the treatment plan
    - Be available for the first treatment and assist with verification for subsequent treatments as necessary

Radiation therapist

- Qualifications
    - [MRT(T)] graduate of a recognized radiation therapy program with registration with the appropriate provincial college
    - Considered beneficial if trained in a spine SBRT-specific setting (within an SBRT program or by a supervised vendor)
- Responsibilities of the radiation therapist must be clearly defined and may include the following:
    - Appropriate fabrication of effective patient immobilization devices
    - Patient treatment preparation for the spine SBRT procedure that includes patient positioning/immobilization
    - Performing and assessing pre-treatment imaging for treatment verification
    - Monitoring the patient during treatment
    - Delivering accurate spine SBRT treatment after appropriate approvals
    - Patient care and side effect management
    - Organizing daily workflow of patients and staff
    - Performing daily QA and ensuring safe operation of the technology unit
    - Performing emergency procedures adhering to protocols if necessary
    - Note: In some spine SBRT procedure centers, RTs would be engaging with diagnostic imaging at the time of MRI to ensure proper imaging techniques

Qualifying Statements for Recommendation 2

- Responsibilities may be reassigned where appropriate provided all qualifications and training standards are met
- Support for continuing education for personnel may also be beneficial it is possible that one individual could fulfil both the responsibilities of the radiation therapist and medical dosimetrist, if the appropriate qualifications are obtained

Recommendation 3

The following are recommended for minimum applicable equipment and imaging requirements for simulation and delivery of spine SBRT. Predominant technologies that are employed in Ontario for the delivery of spine SBRT include:

- Image-Guided Linear Accelerator (Linac) with a sub-centimetre multileaf collimator (MLC)
- CyberKnife

Qualifying Statements for Recommendation 3

- Other units may be available; however, in Ontario these are the most common delivery apparatus used for spine SBRT delivery within the province
- Only image-guided technologies should be used for spine SBRT
- While a sub-centimetre MLC is sufficient and safe for the delivery of spine SBRT, a Linac with a ≤5 mm MLC is ideal
- In addition, the recommendations and guidelines presented apply to any technology that a centre would use for spine SBRT

Recommendation 4

The following are recommended as the appropriate level of Simulation and Immobilization for patients undergoing spine SBRT in Ontario

Simulation

- Simulation (includes the mandatory acquisition of volumetric axial MR imaging [MRI]) treatment should be performed as close as possible to the treatment delivery date and optimally no longer than seven and certainly no more than 14 days (including weekend days and statutory holidays) from the treatment delivery date. In the case of epidural disease, treatment should be completed no more than seven days (including weekend days and statutory holidays) from the date of simulation

MRI parameters

- MR axial T1 and T2 sequences of no more than 1-2 mm in slice thickness that include one to two vertebral segments above and below the SBRT target vertebral segments
- MR axial T1 and T2 sequences should be acquired without gadolinium; if a post gadolinium axial is requested then it represents a third sequence to be fused
- Multiple simulation MRI sequences may be required based on the number and location of the spinal segments to be treated to ensure accurate fusion to the treatment planning computed tomography (CT). For example, when treating a T12 and a L5 metastasis, then the simulation MRI should include as a minimum acquisition from T11 to L1 and from L4 to S1 and not one imaging set from T11 to S1
- Contouring of the clinical target volume (CTV) is based on the fusion of the MRI to the planning CT. Several guidelines, review articles and the Canadian Cancer Trials Group (CCTG)-led Symptom Control-24 (CCTG SC24) randomized controlled protocol are recommended to guide practice (2-8)

CT parameters

- CT simulation slice thickness should not exceed 2 mm. Intravenous contrast is optional
- If a treatment-planning CT myelogram is performed then the intrathecal contrast should be injected just prior to the treatment-planning CT, such that the CT is acquired in the simulation suite with the patient immobilized in the treatment position and contrast in place. The acquisition of a diagnostic CT myelogram, which is not acquired with the

patient immobilized and in the treatment position, is discouraged as fusion to the treatment-planning CT is an additional potential source of error. It is important to note that this procedure does not replace the process of acquiring treatment planning MR images for fusions

Immobilization

- For lesions that are at the region of T4 and above, the SBRT for Spine Working Group recommends a thermoplastic head and neck mask
- For lesions below the region of T4, the Working Group recommends near-rigid body immobilization. If less robust immobilization is applied, the image guidance procedures should be modified to ensure an overall **planning target volume (**PTV) margin of no more than 2-3 mm and spinal cord planning organ at risk volume (PRV) of no more than 2 mm. Typically the modifications can include intra-fraction cone-beam CT (CBCT) imaging and/or stereoscopic intra-fraction x-ray-based imaging. In these scenarios full six degrees of freedom positional corrections must be applied

Qualifying Statements for Recommendation 4

- The Working Group members recognize that the MRI acquisitions are dependent on the scanner on which the imaging is performed at the spine SBRT centre
- Involvement of medical physics and radiation therapy to review the entire MRI procedure (from image acquisition to fusion) with end-to-end testing is strongly recommended to minimize the risks associated with geometric distortion especially if using a 3T scanner
- In some instances, images may come from diagnostic departments that are not within the dedicated spine SBRT centre. In these cases, special QA considerations should be given to those images, as they may not meet the minimum recommendation parameters for simulation
- For CT, sufficiently high spatial resolution and signal must be used in accordance with guidelines and recommendations

Recommendation 5

The following are recommended for the appropriate level of QA for: (a) treatment-delivery unit/machine quality control (QC); (b) imaging; and (c) treatment planning:

- The responsible medical physicist should determine that the appropriate testing procedure is used, and documentation is maintained
- Online Image Guidance: Image guidance is essential for accurate spine SBRT treatment delivery regardless of what system or accessories are being used. CBCT is a volumetric imaging technique that is available on most modern linacs and strict adherence to QA guidelines covering geometric fidelity, kV-to-MV coincidence, and image quality is essential. Stereoscopic imaging may also be used with adherence to the relevant guidelines. Since treatment delivery time could be lengthy, some consideration of real-time imaging or imaging mid-treatment during treatment should be considered
- Spatial and dosimetric accuracy: Sub-millimetre accuracy of all delivery components (including MLC position/motion accuracy, isocentricity, couch motions, etc.) should be strictly maintained via the QA program. When considering QA recommendations, it is recommended to use “stereotactic radiation (SRS)/SBRT” tolerances as appropriate, which are more stringent than conventional external beam radiotherapy (cEBRT) techniques. For example, in TG-142, the “SRS/SBRT” specifications should be applied as needed for all machine and imaging-related procedural tests. A positional end-to-end

test for delivery accuracy is recommended that encompasses as much of the workflow as possible, from MRI, through to target delineation and treatment delivery. For reference dosimetry in linacs, standard protocols TG-51 (9) and IAEA TRS-398 (10) apply as well as recommendations as per TRS-483 using MSR fields if using CK (11). It is recommended that a medical physicist on the SBRT team have some dedicated small-field dosimetry training, whether through a certified medical physics training program, or by experienced physicists with small-field dosimetry expertise
- Every spine SBRT treatment plan should be subject to recommended patient-specific QC checks. In the case of linac-based spine SBRT, guidelines for patient-specific QC are listed below under Qualifying Statements

Qualifying Statements for Recommendation 5
- These recommendations are specific to spine SBRT and are in addition to existing guidance documents made available by the treatment unit manufacturer and international and national guidelines
- It is recommended that a medical physicist on the spine SBRT team have dedicated small-field dosimetry training, whether through a certified medical physics training program, or by a combination of continuing education courses and direct training by experienced physicists with small-field dosimetry expertise
- An audit/credentialing procedure (example: IROC) would be highly beneficial in establishing new spine SBRT programs or for credentialing for clinical trials. Several reports have indicated that systematic variability among clinics can be reduced via such independent dose-audits (12-14)
- The patient-specific QC program should follow established guidelines:
    - NCS (Netherlands) Report 28 (2018: QA Audit IMRT and VMAT) (15)
    - AAPM TG 218 (2018: IMRT Tolerances and Methodology) (16)
    - ICRU 83 (2010: IMRT Plan Evaluation) (17)

Recommendation 6
The following are **the minimum recommended requirements for patient follow-up after spine SBRT treatment (i.e., MRI timing and frequency):**
- Follow-up of SBRT patients should consist of routine clinical visits for the first year (every 3 months); second and third year (every 3-6 months); and every four to six months thereafter, as determined by the MCC

Qualifying Statements for Recommendation 6
- Spinal MRI and not CT or x-ray is the appropriate imaging modality for treatment response monitoring
- A routine clinical visit incorporates a standard full spine MRI, or at a minimum an MRI of the involved spinal region (cervical, thoracic, or lumbar depending on the anatomic location of the treated spinal segment). Gadolinium is not required
- The details of the follow-up plan may be clarified at the discretion of the MCC based on the histology of the spine metastases and the clinical context (for example, a patient with hormone sensitive metastatic prostate cancer treated with spinal SBRT and an undetectable prostate-specific antigen may continue on six-monthly MRI follow-up after the third year of follow-up or delayed to every nine to 12 months if the MCC recommends a more protracted schedule)

REFERENCES

1. Wright F DVC, Langer B, Hunter A; Expert Panel on the Multidisciplinary Cancer Conference Standards. . Multidisciplinary cancer conference standards. Toronto (ON): Cancer Care Ontario; 2006 [Available from: https://www.cancercareontario.ca/en/guidelines-advice/types-of-cancer/286.
2. Burgess L, Zeng KL, Myrehaug S, Soliman H, Tseng CL, Detsky J, et al. Stereotactic Body Radiation Therapy for Posterior Element-Only Spinal Metastases: A First Report on Outcomes and Validation of Recommended Clinical Target Volume Delineation Practice. Pract Radiat Oncol. 2023.
3. Cox BW, Spratt DE, Lovelock M, Bilsky MH, Lis E, Ryu S, et al. International Spine Radiosurgery Consortium consensus guidelines for target volume definition in spinal stereotactic radiosurgery. Int J Radiat Oncol Biol Phys. 2012;83(5):e597-605.
4. Dunne EM, Lo SS, Liu MC, Bergman A, Kosztyla R, Chang EL, et al. Thecal Sac Contouring as a Surrogate for the Cauda Equina and Intracanal Spinal Nerve Roots for Spine Stereotactic Body Radiation Therapy (SBRT): Contour Variability and Recommendations for Safe Practice. Int J Radiat Oncol Biol Phys. 2022;112(1):114-20.
5. Dunne EM, Sahgal A, Lo SS, Bergman A, Kosztyla R, Dea N, et al. International consensus recommendations for target volume delineation specific to sacral metastases and spinal stereotactic body radiation therapy (SBRT). Radiother Oncol. 2020;145:21-9.
6. Guckenberger M, Dahele M, Ong WL, Sahgal A. Stereotactic Body Radiation Therapy for Spinal Metastases: Benefits and Limitations. Semin Radiat Oncol. 2023;33(2):159-71.
7. Redmond KJ, Robertson S, Lo SS, Soltys SG, Ryu S, McNutt T, et al. Consensus Contouring Guidelines for Postoperative Stereotactic Body Radiation Therapy for Metastatic Solid Tumor Malignancies to the Spine. Int J Radiat Oncol Biol Phys. 2017;97(1):64-74.
8. Sahgal A, Myrehaug SD, Siva S, Masucci GL, Maralani PJ, Brundage M, et al. Stereotactic body radiotherapy versus conventional external beam radiotherapy in patients with painful spinal metastases: an open-label, multicentre, randomised, controlled, phase 2/3 trial. Lancet Oncol. 2021;22(7):1023-33.
9. P.R. Almond PJB, B.M. Coursey, W.F. Hanson, M.S. Huq, R. Nath and D.W.O., Rogers ATG. 51: Protocol for clinical reference dosimetry of high energy photon and electron beams. Med Phys. 1999;26:1847-70.
10. IAE A. Implementation of the International Code of Practice on Dosimetry in Radiotherapy (TRS 398): Review of Test Results. Vienna: INTERNATIONAL ATOMIC ENERGY AGENCY; 2005.
11. IAE A. Dosimetry of Small Static Fields Used in External Beam Radiotherapy. . Vienna: INTERNATIONAL ATOMIC ENERGY AGENCY; 2017.
12. Edward SS, C. Glenn M, Peterson CB, Balter PA, Pollard-Larkin JM, Howell RM, et al. Dose calculation errors as a component of failing IROC lung and spine phantom irradiations. Medical Physics. 2020;47(9):4502-8.
13. Rijken J, Jordan B, Crowe S, Kairn T, Trapp J. Improving accuracy for stereotactic body radiotherapy treatments of spinal metastases. J appl clin med phys. 2018;19(5):453-62.
14. Hardcastle N, Kron T, Cook O, Lehmann J, Mitchell PLR, Siva S. Credentialing of vertebral stereotactic ablative body radiotherapy in a multi-centre trial. Phys Med. 2020;72:16-21.
15. Seravalli E, Houweling AC, Van Battum L, Raaben TA, Kuik M, de Pooter JA, et al. Auditing local methods for quality assurance in radiotherapy using the same set of predefined treatment plans. Physics and Imaging in Radiation Oncology. 2018;5:19-25.

16. Miften M, Olch A, Mihailidis D, Moran J, Pawlicki T, Molineu A, et al. Tolerance limits and methodologies for IMRT measurement-based verification QA: Recommendations of AAPM Task Group No. 218. Med Phys. 2018;45(4):e53-e83.
17. Hodapp N. The ICRU Report 83: prescribing, recording and reporting photon-beam intensity-modulated radiation therapy (IMRT). Strahlentherapie und Onkologie : Organ der Deutschen Röntgengesellschaft [et al]. 2012;188:97-9.