Commentary

Radiotherapy is the most effective cancer treatment after surgery, contributing to the cure of approximately 40% of malignant diseases as a standalone modality. Its therapeutic potential was recognized almost immediately after the discovery of X-rays in 1895, with the first attempts at using radiation for the treatment of breast cancer patient documented just days after its discovery. Since then, radiotherapy has focused on increasing dose precision, improving biological effectiveness, and shortening the overall treatment duration. These advancements are most evident in stereotactic radiotherapy, sometimes referred to as radiosurgery.

Stereotactic radiotherapy represents a modern approach to cancer treatment, offering the ability to deliver highly precise and intense radiation doses directly to tumor sites while minimizing exposure to surrounding healthy tissues. This technique utilizes advanced linear accelerators with sophisticated imaging guidance, tumor motion monitoring, rapid dose delivery, and stringent quality control systems. These technological innovations allow for the safe administration of higher radiation doses, leading to improved local tumor control and increased patient survival rates.

Initially, this method was exclusively used for treating lesions in the immobile brain. However, technological advancements in the 1990s enabled its expansion to extracranial lesions, whose positioning is influenced by respiratory movements or gastrointestinal tract activity. Since then, stereotactic radiotherapy has undergone continuous refinement—new imaging techniques, more precise treatment planning systems, enhanced tumor motion management, and modern quality control mechanisms have significantly improved the safety and effectiveness of the treatment.

Clinical studies have clearly demonstrated the high efficacy of extracranial stereotactic radiotherapy (SBRT) in treating both primary tumors and metastatic lesions. Its excellent local tumor control, prolonged overall survival, and minimal side effects have established SBRT as a standard treatment option for localized non-small cell lung cancer, liver, kidney, pancreatic, and prostate tumors, as well as for primary malignant and benign tumors of the spine and spinal cord. A significant subset of patients benefiting from this approach includes those with oligometastatic disease, characterized by a limited number of metastatic lesions and affected organs. These patients particularly benefit from targeted treatment strategies.

Moreover, stereotactic radiotherapy is increasingly being explored for new indications, including breast cancer, head and neck tumors, gynecologic malignancies, and advanced

polymetastatic disease. A key challenge for the future is harnessing the synergistic potential of SBRT in combination with modern immunotherapeutic agents, which could extend its application to previously experimental areas.

The curative — ablative — potential of stereotactic radiotherapy is better reflected in its more recent designation: SABR (stereotactic ablative radiotherapy). This term aligns the technique with other ablative modalities, such as surgery, radiofrequency ablation, and thermal ablation. Today, SABR has become a standard clinical reality and represents a significant milestone in cancer treatment. The ability to condense radiotherapy into just 1–3 fractions and achieve tumor eradication within a week provides substantial medical, social, and economic benefits for patients and healthcare systems alike. Ensuring access to effective care for all patients is one of the key objectives of modern oncology, and SABR plays a significant role in achieving this goal.

This study focuses on extracranial stereotactic radiotherapy (SBRT) and its application in oncology. It describes the fundamental principles and indications of the method, the technologies used in treatment planning and delivery, and provides an overview of potential side effects and their management. The text is systematically structured according to tumor localization and covers both primary tumors and oligometastatic disease. In addition to theoretical insights, it includes personal clinical experience documented in peer-reviewed publications on the treatment of primary lung and pancreatic tumors, as well as oligometastatic disease affecting the lungs, liver, and lymph nodes. The entire work is conceived as a commented collection of published papers. The individual studies are interwoven throughout the text and referenced in thematically relevant sections.

The rapid advancement of stereotactic techniques has facilitated their increasing use in modern oncology, even in areas previously considered outside their standard indications. Our institution has implemented SBRT technology in the adjuvant treatment of low-risk breast cancer, specifically for targeted irradiation of the tumor bed following breast-conserving surgery. As part of a grant-funded project on accelerated partial breast irradiation (APBI; PI dr. Burkoň), clinical evaluations were conducted to assess the feasibility and safety of this method. The study results confirmed not only its practical applicability in clinical practice but also its oncological efficacy and low toxicity. These findings open new possibilities for the broader use of SBRT in individualized treatment strategies for patients with low-risk early-stage breast cancer. The results of this project have been published in peer-reviewed journals and are included in this study.

1. **BURKOŇ, P.**, M. SLÁVIK, T. KAZDA, P. POSPÍŠIL, T. PROCHÁZKA, M. VRZAL and P. ŠLAMPA. Stereotactic body radiotherapy - Current indications [Extrakraniální stereotaktická radioterapie – přehled současných indikací]. *Klinicka onkologie* [online]. 2019, **32**(1), 10–24. Available at: doi:10.14735/amko201910
   Document type: Review; Category: ONCOLOGY; SJR: Q4.

The review article published in Klinická onkologie provides a fundamental overview of the indications for stereotactic body radiotherapy (SBRT), the radiation doses used, and potential side effects. Thanks to advances in imaging guidance, treatment planning, and dose delivery, SBRT has become a standard part of treatment for primary tumors and oligometastases, particularly in cases where resection is not an option. It has curative potential in lung and prostate cancers and can extend survival in oligometastatic disease while delaying the need for systemic therapy, thereby improving patients' quality of life. It also discusses other indications, such as pancreatic cancer and hepatocellular carcinoma. The article was awarded the Best Publication Prize in Klinická onkologie in 2019.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
80	25	80	25

2. **BURKOŇ, Petr**. Extrakraniální streotaktická radioterapie. In: Pavel ŠLAMPA. *Radiační onkologie: pro postgraduální přípravu i každodenní praxi.* Praha: Maxdorf, 2021, s. 597-615. ISBN 978-80-7345-674-0.

The book Radiation Oncology, led by Prof. MUDr. Pavel Šlampa, CSc., provides an overview of current knowledge and recommended procedures in the field of radiation oncology. It focuses on the therapeutic use of ionizing radiation in the treatment of malignant diseases, which has undergone significant technological and clinical advancements in recent years, fundamentally influencing oncological treatment strategies. The book serves as a practical guide for daily clinical practice as well as a study resource for specialization exams. Dr. Burkoň is the lead author of the chapter on stereotactic ablative radiotherapy (SABR), which offers a detailed insight into the practical aspects of this method. It provides a clear overview of its key indications, references relevant literature, and discusses the technical aspects of treatment planning, radiation delivery, potential side effects, and patient follow-up. This chapter serves as a key guide for the proper implementation of stereotactic therapy in oncological practice.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
100	100	100	100

3. **BURKOŇ, P.**, J. TRNA, M. SLÁVIK, R. NĚMEČEK, T. KAZDA, P. POSPÍŠIL, M. DASTYCH, M. EID, I. NOVOTNÝ, T. PROCHÁZKA and M. VRZAL. Stereotactic Body Radiotherapy (SBRT) of Pancreatic Cancer—A Critical Review and Practical Consideration. *Biomedicines* [online]. 2022, **10**(10, Article number 2480). Available at: doi:10.3390/biomedicines10102480
Document type: Article review; IF = 4,7; Quartile by IF: MEDICINE, RESEARCH & EXPERIMENTAL Q2; Quartile by AIS: MEDICINE, RESEARCH & EXPERIMENTAL Q3.

The review article published in Biomedicines in 2022 explores stereotactic body radiotherapy (SBRT) as a promising treatment approach for unresectable locally advanced pancreatic cancer. Pancreatic cancer is the third most common cause of cancer-related death in developed countries, with an incidence that continues to rise. Surgical resection remains the only curative option, but for most patients, it is not feasible. Neoadjuvant therapy, combining systemic treatment with radiotherapy, may increase patients' chances of successful treatment.

Compared to conventional radiotherapy, SBRT offers several advantages — it allows for higher radiation doses to the tumor while minimizing exposure to surrounding tissues, shortens treatment duration, and can be better integrated with chemotherapy. The article provides an overview of current evidence on SBRT indications for pancreatic tumors, describes practical aspects of treatment planning and delivery, and discusses the future potential of MR- linac systems. The combination of SBRT with modern cytostatics may help extend patient survival from months to years.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	40	70	40

4. **BURKON, P.**, T. KAZDA, P. POSPISIL, M. SLAVIK, L. KOMINEK, I. SELINGEROVA, D.M. BLAKAJ, T. PROCHAZKA, M. VRZAL, Z. REHAK and P. SLAMPA. Ablative dose stereotactic body radiation therapy for oligometastatic disease: a prospective single institution study. *Neoplasma* [online]. 2019, **66**(2), 315–325. Available at: doi:10.4149/neo_2018_180731N558
Document type: Article; IF = 1.721; Quartile by IF: ONCOLOGY Q4; Quartile by AIS: ONCOLOGY Q4.

This paper summarises the results and conclusions of a prospective single-institution study focused on the use of high-dose radiotherapy in the treatment of oligometastatic involvement of the lungs and liver with metastases from various primary tumors. Stereotactic radiotherapy/radiosurgery is a highly effective, non-invasive ablative treatment method with curative potential for managing oligometastatic disease. More than one-fifth of patients treated in this way achieve long-term survival (over 8 years) without any signs of disease. Dr. Burkoň's team was the first to implement a stereotactic program in clinical practice in the Czech Republic.

The aim of this study was to analyse long-term survival, tumor control outcomes, and safety of stereotactic radiotherapy in an unselected cohort of patients from real-world clinical practice in oligometastatic settings. Consistent with other publications, findings confirmed that the effectiveness of this treatment increases with the applied dose and decreases with the number of irradiated lesions. In addition to standard toxicity and survival parameters, we report unique outcomes, such as the time to polymetastatic conversion of the disease and the time until the need for subsequent oncologic treatment. Finally, we demonstrated that this treatment represents a safe and effective option for managing oligometastatic disease, with approximately 30% of patients not requiring subsequent oncologic treatment two years after SBRT.

Within Czech radiation oncology, this was the first significant publication addressing the outcomes of stereotactic radiotherapy for oligometastatic disease in the Czech Republic. In 2023, the paper was cited in Lancet Oncology as one of the sources for the meta-analysis used to develop recommendations for combining SBRT with systemic targeted therapies. In 2024, it was cited in Lung Cancer as one of the key sources used in developing SBRT treatment recommendations for oligometastatic lung disease.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
65	70	60	70

5. **BURKON, P.**, I. SELINGEROVA, M. SLAVIK, P. POSPISIL, L. BOBEK, L. KOMINEK, P. OSMERA, T. PROCHAZKA, M. VRZAL, T. KAZDA and P. SLAMPA. Stereotactic Body Radiotherapy for Lymph Node Oligometastases: Real-World Evidence From 90 Consecutive Patients. *Frontiers in Oncology* [online]. 2021, **10**(Article number 616494). Available at: doi:10.3389/fonc.2020.616494
   Document type: Article; IF = 5.738; Quartile by IF: ONCOLOGY Q2, Quartile by AIS: ONCOLOGY Q2.

The aim of this publication was to evaluate the efficacy and toxicity of extracranial stereotactic body radiotherapy (SBRT) in treating oligometastatic lymph node involvement in the mediastinum, retroperitoneum, and pelvis in a consecutive group of patients from real-world clinical practice outside clinical trials.

Stereotactic radiotherapy/radiosurgery is a highly effective, non-invasive ablative treatment method with significant therapeutic potential in managing oligometastatic disease from various primary tumors. Due to respiratory and peristaltic movements, as well as the radiosensitivity of surrounding tissues and organs, targeted high-dose irradiation of oligometastases in lymph nodes was technically unfeasible for a long time. Following successful treatment of lesions in the lungs and liver, leading institutions began applying this approach to lymph node metastases.

Our study confirmed that targeted radiotherapy is a highly effective and low-toxicity treatment for oligometastatic lymph node involvement. It has curative potential, with 27%

of patients in our study achieving long-term survival without any progression (local, regional, or distant), effectively showing no signs of oncological disease. Additionally, it can delay the start of cytotoxic chemotherapy, thereby improving and preserving patients' quality of life.

Within Czech radiation oncology, this is a unique publication — no similar paper from other Czech radiation oncology departments has been published to date.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
70	65	70	70

6. **BURKON, P.**, I. SELINGEROVA, M. SLAVIK, M. HOLANEK, M. VRZAL, O. COUFAL, K. POLACHOVA, P. MULLER, P. SLAMPA and T. KAZDA. Toxicity of external beam accelerated partial-breast irradiation (APBI) in adjuvant therapy of early-stage breast cancer: prospective randomized study. *Radiation Oncology* [online]. 2024, **19**(1, Article number 17). Available at: doi:10.1186/s13014-024-02412-x
Document type: Article; IF= 3.3; Quartile by IF: ONCOLOGY Q2, RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING Q1; Quartile by AIS: ONCOLOGY Q2, RADIOLOGY, NUCLEAR MEDICINE & MEDICAL IMAGING Q1.

This publication presents the results of a grant project (AZV: NV19-03-00354, Trial registration: NCT06007118) evaluating an innovative approach to adjuvant partial breast irradiation as part of breast-conserving therapy for patients with low-risk breast cancer. Dr. Burkoň was the principal investigator of this prospective randomized trial.

Compared to the commonly used whole breast irradiation regimen, the studied technique, APBI (Accelerated Partial Breast Irradiation), offers an approach where radiation is delivered to a smaller target volume in less time, resulting in improved patient convenience, reduced toxicity, and cost savings. Our technique of external APBI, using the technique of stereotactic body radiotherapy (SBRT), was found to be very well tolerated, easy to perform, and safe. This schedule represents an attractive treatment option that is both safe and effective. In the long term, a short-course, once-daily external beam regimen is likely to become the preferred method, balancing effectiveness, convenience, and side effects for patients undergoing adjuvant partial breast radiation.

This publication confirmed the level of evidence necessary for implementing this technique of external APBI into daily clinical practice. Recent advancements in radiation oncology demonstrate a rapid transition toward precision medicine strategies. In this context, our study technique represents a paradigm shift toward effective treatment de-escalation for selected hormone-sensitive early breast cancer cases. Within Czech radiation oncology, this is the first publication addressing this issue.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
65	60	70	70

7. **BURKON, P.**, I. SELINGEROVA, M. VRZAL, M. HOLANEK, O. COUFAL, K. POLACHOVA, V. ANDRASKOVA, S.R. JHAWAR, P. SLAMPA, T. KAZDA and M. SLAVIK. Quality of life in early breast cancer patients after adjuvant accelerated partial-breast irradiation (APBI) in randomized trial. *Scientific Reports* [online]. 2025, **15**(1, Article number 1387). Available at: doi:10.1038/s41598-025-85342-2
Document type: Article; IF = 3.8; Quartile by IF: MULTIDISCIPLINARY SCIENCE Q1; Quartile by AIS: MULTIDISCIPLINARY SCIENCE Q1.

This prospective randomized study compared the quality of life in patients with low-risk breast cancer after partial mastectomy, who were treated with highly targeted stereotactic radiotherapy of the tumor bed (external APBI) or moderately hypofractionated whole-breast irradiation (hypo-WBI). It followed up on a 2023 publication, which evaluated the feasibility, safety, and toxicity of this new method. In this study, both patient groups were assessed using quality of life questionnaires (QLQ-C30 and QLQ-BR45), completed before treatment and at multiple time points up to 24 months after radiotherapy.

The analysis showed that APBI did not result in worse short- or long-term outcomes compared to hypo-WBI. Patients treated with APBI reported lower levels of pain, systemic discomfort, and breast-related symptoms, with the most pronounced differences observed shortly after radiotherapy, when hypo-WBI was associated with higher toxicity and reduced physical performance.

The results suggest that APBI is a well-tolerated and safe treatment, which could be a preferred alternative to hypo-WBI for low-risk early-stage breast cancer, primarily due to its positive impact on patients' quality of life. In the context of modern individualized oncologic care, this study highlights the importance of quality of life as a key factor in decision-making regarding optimal post-lumpectomy treatment.

Experimental work (%)	Supervision (%)	Manuscript (%)	Research direction (%)
65	60	70	75