Annotated Bibliography

Clinical applications of magnetic resonance-guided radiotherapy: a narrative review. (2023). *Cancers*, *15*(11), 2916.

Magnetic resonance-guided radiotherapy (MRgRT) is an innovative approach in radiotherapy that integrates real-time MRI with radiation delivery. This technique involves using a linear accelerator equipped with either low-field or high-field MRI, which enhances precision in targeting and avoiding tissues by adjusting for daily anatomical changes. This reduction in uncertainty allows for smaller, less toxic treatment margins and higher doses of radiotherapy, potentially improving tumor control. MRgRT has shown effectiveness in treating various cancers such as breast, prostate, pancreatic, liver, lung, and some metastatic types, as well as in non-cancer treatments like cardiac ablation. This review discusses the current advancements and future directions of MRgRT technology and research.

This source is valuable because it explores both low and high magnetic resonance-guided radiotherapy (MRgRT) fields and highlights how it differs from standard radiation treatments that use CT scans. The article details the criteria for patient eligibility for MRgRT, along with trials and outcomes of various treatments using this technology. However, a limitation of this source is that it does not address the contraindications or identify patients who may not be suitable for this treatment. It discusses how MRgRT can improve workflow, highlighting the role of artificial intelligence in providing a foundational framework for contouring, which aids specialists in this task. Nonetheless, it lacks specific insights into how this technology impacts radiation therapists directly, especially regarding their transition from CT to this advanced modality.

GenesisCare UK (2021, July 2). *ViewRay MRIdian MR linac explained.* [Video]. YouTube.

This video provides an in-depth look at the MRIdian MR Linac machine, emphasizing its integration of MRI technology into radiation therapy. It demonstrates how this system improves image guidance and targeting accuracy in radiotherapy through real-time, on-table adaptive radiotherapy. The MRIdian features a split magnet design that ensures an unobstructed radiation beam path and an optimal source axis distance. A key highlight is the SmartVISION™ technology, which mitigates the risk of skin toxicities and prevents the occurrence of trapped or distorted doses. Additionally, the system incorporates multileaf collimator (MLC) faces that maintain parallel alignment with the beam path, facilitating double focusing for reduced penumbra. Clinicians can quickly produce dailyon-table MRI setup scans within seconds, allowing for swift adjustments to dose delivery that account for subtle daily anatomical changes. Moreover, the SmartTARGET™ technology is capable of detecting even minor intrafraction motion during beam delivery, enabling oncologists to visualize the tumor's boundaries and surrounding area in real time through a non-ionizing video perspective. Lastly, the MRIdian is designed for easy integration into any existing standard linear accelerator vault and shielding configuration, making it a flexible enhancement for radiation therapy facilities.One of the notable strengths of this video is its thorough exploration of the MRIdian machinery, particularly the functionality of the multileaf collimators. This detailed explanation provides viewers with a strong understanding of how these components work and their significance in optimizing treatment precision. Additionally, the video effectively highlights the various Smart Technologies incorporated into the system, emphasizing the benefits and advancements they bring to the field of radiation therapy. This information not only enhances the viewer's comprehension of the technology but also underscores its innovative applications in clinical

practice. However, the video does have some weaknesses. It does not go into detail regarding the specific indications and contraindications for receiving treatment with the MRIdian, which could leave viewers wanting more clarity on when this machine is appropriate for use. Furthermore, the video lacks a discussion on the different types of cancers that can be treated using the MRIdian. Including this information would provide a more comprehensive understanding of the machine's capabilities and potential applications in oncology, enriching the content and making it more informative for healthcare professionals and patients alike.

MRI-LINAC: A transformative technology in radiation oncology. (2023). *Frontiers in Oncology, 13*, 1117874.

This article explores how magnetic resonance-guided radiotherapy (MRgRT) stands out as the optimal solution for addressing the challenges faced by traditional radiation therapy, particularly in therapy guidance, treatment verification, and delivery control. It examines different MRgRT platforms, highlighting their unique features in construction, treatment delivery, imaging, and gating capabilities. The article delves into significant advancements in image-guided radiotherapy enabled by MRI-Linac technology, showcasing improvements through diverse treatment imagery. It also addresses limitations such as cost, treatment duration, delivery constraints, and contraindications. Cancers such as prostate, lung, liver, pancreatic, breast, and central nervous system tumors are highlighted as treatable with this technology. Additionally, the article discusses MRI's potential to combine morphological and functional data for predicting treatment responses, while also considering its capacity to assess cell metabolism and death.

This article effectively highlights the strengths of utilizing MRgRT in treatment by detailing every stage, from pre-treatment planning and simulation to image-guided treatment verification, real-time re-planning, and delivery. It addresses the shortcomings of conventional treatment processes and demonstrates how MRgRT can overcome these hurdles in multiple ways. Additionally, the article discusses the limitations of MRgRT and suggests potential solutions for future improvements. However, a drawback of the article is its lack of discussion on the impact of this new technology on healthcare professionals, such as therapists, physicians, dosimetrists, and physicists. While it notes the issue of patient comfort related to claustrophobia, it doesn't sufficiently detail specific setup protocols needed for treatments involving the enclosed MR-Linac, compared to the more open traditional radiation treatment machines.

Magnetic Resonance Imaging. (2023). In Rollins, J. H., Long, B. W., & Curtis, T (Ed.), *Merrill's atlas of radiographic positioning and procedures* (3rd ed., pp. 454-481). Elsevier.

This chapter provides a comprehensive overview of the principles underlying magnetic resonance imaging (MRI) and draws a comparison between conventional radiography and MRI. It emphasizes best practices in the field, covering critical areas such as safety protocols, appropriate examination procedures, and effective patient management. The historical development of MRI is explored, alongside a thorough examination of the physical principles that govern its operation. Detailed descriptions of the equipment used, the magnet room, and console operation are included to enhance understanding. Furthermore, the chapter delves into infection control measures and outlines examination protocols, including imaging parameters, patient positioning, and the use of coils. The significance of patient monitoring is emphasized, along with an informative section on contrast media and gating techniques.Clinical applications

of MRI are also discussed in depth, showcasing its relevance in assessing the central nervous system, chest, abdomen, pelvis, musculoskeletal system, vascular structures, and the processes of diffusion and perfusion. Finally, the chapter addresses spectroscopy and provides insights into functional magnetic resonance imaging, highlighting its evolving role in medical diagnostics.

This resource excels in several areas. Notably, it includes a dedicated section on best practices,outlining essential knowledge for technologists operating magnetic machinery. It underscores the critical importance of pre-screening patients, equipment staff, and visitors to mitigate risks associated with the high magnetic fields. Additionally, it features a comprehensive section on MRI safety, emphasizing the role of ferromagnetic detection systems in enhancing screening processes prior to entering the magnetic field. The section also covers key patient preparation steps, such as removing clothing to avoid contact burns, and stresses the significance of educating patients to alleviate claustrophobia-related fears.However, the chapter has a few shortcomings. It lacks detailed information on the use of immobilization devices during the examination and insufficiently addresses the importance of remaining still for accurate results. Moreover, it does not adequately emphasize the typical duration of an MRI, which is a critical piece of information for patient preparation and expectations.

Radiation oncology. (2023). In Rollins, J. H., Long, B. W., & Curtis, T (Ed.), *Merrill's atlas of radiographic positioning and procedures* (3rd ed., pp. 454-481). Elsevier.

This chapter provides a comprehensive overview of radiation oncology, outlining its foundational principles and historical evolution. It offers a general definition of cancer and explores its impact on the body, delving into risk factors, including both internal and external influences, and discussing the tissue origins of cancer. The chapter elaborates on the theory of

radiation treatment, focusing on the effectiveness of LET (Linear Energy Transfer) and RBE (Relative Biological Effectiveness). It details various cancer treatments and the specific equipment used to administer these therapies. Additionally, it provides an in-depth explanation of the treatment process, encompassing simulation, dosimetry, and the treatment phases.

The chapter also highlights best practices in radiation therapy and examines future trends in the field, while providing an index of definitions for unfamiliar terms. Among its strengths are the meticulous categorization of different cancer types and treatments, as well as a section dedicated to best practices that radiation therapists should follow. However, the chapter could be enhanced by offering more detailed educational pathways for aspiring radiation therapists and a more thorough exploration of the long-term effects of radiation treatment on patients.