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### AlignRT in Radiation Therapy

Collin N. Domozych  
*Misericordia University*

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## What is Radiation Therapy?

- Radiation therapy is a treatment used to fight cancer. It works by delivering high-energy radiation to damage the DNA inside cancer cells. This stops the cells from growing and dividing, which eventually causes them to die (Mayo Clinic, 2024).
- The most common type is external beam radiation therapy, which uses a machine called a linear accelerator to deliver radiation from outside the body to a specific area being treated (Rollins et al., 2022).
- Radiation therapy is used to treat many different types of cancer and even noncancerous conditions such as osteoarthritis. Radiation therapy can also be combined with other treatments or used to help relieve symptoms in patients with advanced cancer (Mayo Clinic, 2024).

## What is AlignRT?

- AlignRT is a surface-guided radiation therapy (SGRT) system that assists with patient positioning during radiation therapy treatment.
- Surface imaging is used to monitor a patient's body surface and help align the patient before radiation is delivered. Accurate patient positioning is essential to ensure that the radiation dose is delivered to the tumor while minimizing exposure to healthy tissues.
- AlignRT is an alternative to traditional positioning techniques that rely on skin tattoos and laser alignment. Surface guidance systems, such as AlignRT, can support accurate patient setup and enable tattoo-free treatments. (Malhotra et al., 2025).



Figure 1A, Patient on a radiation therapy table using AlignRT for precise positioning (Kaučić et al., 2022, p. 2164).

## Clinical Applications of AlignRT

- 3-D cameras track the patient's skin surface in real time, and if the patient moves outside of the planned treatment position, the system can automatically pause the radiation beam to maintain accuracy and safety (Li, 2022).
- AlignRT is used for breast cancer radiation therapy for patients receiving treatment to the left breast to reduce radiation exposure to the heart (Al-Hallaq et al., 2022).
- Used in stereotactic body radiation therapy (SBRT) and stereotactic radiosurgery (SRS), helping deliver high radiation doses to tumors while protecting nearby healthy tissues (Al-Hallaq et al., 2022).
- Used in other treatment sites, including head and neck, prostate, lung, abdominal extremity, and pediatric cancers (Al-Hallaq et al., 2022).

## Role Of Radiation Therapists

- Radiation therapists ensure the safe and accurate delivery of radiation therapy by positioning patients using immobilization devices and systems like AlignRT for precise alignment (Freislederer et al., 2022).
- During treatment, they operate linear accelerators, monitor motion in real time, and use respiratory gating to maintain treatment accuracy (Freislederer et al., 2022).
- Daily quality assurance tests for surface-guided systems are performed by radiation therapists and reviewed by a qualified medical physicist, while additional monthly and annual tests evaluate system safety, accuracy, camera stability, and overall performance (Al-Hallaq et al., 2022).



(Medical Specialists of Texas, 2026)

## Pros and Cons of AlignRT

### Pros:

- AlignRT captures a 3D body surface to detect and correct patient positioning errors before treatment.
- Reduces the need for repeated imaging verification, helping decrease additional radiation exposure from imaging procedures.
- Provides continuous monitoring of the patient's surface during treatment, allowing therapists to detect motion and maintain accurate radiation delivery throughout the procedure.
- Reduces treatment setup time compared to traditional laser-based positioning methods.
- Used with precise techniques such as deep inspiration breath hold (DIBH), stereotactic body radiation therapy (SBRT), and stereotactic radiosurgery (SRS) to improve treatment accuracy and reproducibility. (Bellala et al., 2023)

### Cons:

- Some treatment sites, including the head, neck, or extremities, may pose difficulties due to limited surface area or irregular shapes. AlignRT may struggle with shadowing, patient movement, or obstruction by immobilization devices. (Bellala et al., 2023)
- Systems are expensive, require dedicated cameras and software, and may not be available in all radiation oncology departments
- AlignRT tracks only the body surface, which may not reflect internal tumor movement, so it cannot fully replace internal imaging. (Bellala et al., 2023)



AlignRT system cameras tracking their position for precise radiation therapy delivery (Vision RT, 2026).

## AlignRT for Pancreatic Cancer

- SBRT is commonly used for advanced pancreatic cancer because it delivers high doses in a small number of treatments (3–5 fractions) while minimizing radiation to nearby organs.
- AlignRT monitors the patient's 3D surface in real time during treatment, providing continuous feedback on positioning.
- If the patient moves outside the acceptable treatment range, AlignRT can automatically pause the radiation beam.
- Breath-hold techniques, like DIBH, are used to limit tumor motion from breathing and reduce radiation dose to nearby organs.
- AlignRT allows continuous monitoring during breath holds, ensuring consistent patient positioning and precise radiation delivery.
- The study reported strong outcomes, including 95.5% one-year local control and minimal toxicity, showing that AlignRT-guided SBRT is effective and safe. (Kaučić et al., 2022).



Figure 1B, Pancreas Setup Using AlignRT. (Kaučić et al., 2022, p. 2164).

## Conclusion

Radiation therapy is essential in cancer treatment, and AlignRT improves its precision and safety through surface imaging. It enhances positioning, reduces unnecessary exposure, and increases dose accuracy. Despite limitations like cost and inability to track internal anatomy, it significantly improves patient safety and treatment quality.