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Surface-Guided Radiation Therapy for Treatment of Various Cancers

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What is Radiation Therapy?

Tumors or lesions are treated by delivering a cancericidal dose of ionizing radiation to region of interest & restricting dose to normal surrounding tissues & structures.

Radiation treatment can be used as definite (primary) treatment, adjuvant treatment (in addition to other forms), & palliation (symptom relief).

Radiation therapy equipment & software technology is advancing, which leads to changes in technique & dose levels.

(Rollins et al., 2023, Chapter 30).

What is Surface-Guided Radiation Therapy (SGRT)?

In SGRT, patient alignment is obtained utilizing camera units & projectors. (Safer Radiation Therapy, 2025, How long is radiation treatment?).

SGRT is a newly advancing type of radiation therapy technology.

SGRT utilizes “visible structured light, stereo-vision systems, time-of-flight systems, or laser scanners to image the surface of a patient with high temporal and spatial resolution without additional radiation dose” (Freislederer et al., 2022, p. 188).

Camera units & projectors capture the real-time three-dimensional (3D) surface of the patient’s body, which is matched to the reference 3D image to locate errors in positioning (Bellala et al., 2023).

Compared to three-point laser setup, SGRT offers greater positioning accuracy & continuous motion monitoring, increasing patient safety by decreasing dose to normal tissue (Bellala et al., 2023).

Advantages of SGRT Over Conventional Approach

SGRT:

- Reduces corrections needed during patient setup, specifically for superficial tumors, decreasing demand for repeat imaging (Blake et al., 2021).
- Eliminates need for permanent skin marks (PMs) on patients, while also revealing needed corrections that are not evident using PMs, including shoulder position (Blake et al., 2021).
- Decreases setup time due to increased patient positioning accuracy compared to conventional laser methods (Kang et al., 2023).
- Supplies monitoring & automated gating during treatments for deep inspiration breath hold (DIBH) (Blake et al., 2021).
- Reduces close contact to lung cancer patients, which prevents spread of COVID-19 (Blake et al., 2021).

A survey of 21 radiation therapists demonstrates SGRT is easy to use & increases accurate patient setup compared to conventional methods (Blake et al., 2021).

Table 2
Results of staff survey regarding experience of SGRTP.

	Yes	No	No difference
Do you think setting patients up using AlignRT is more accurate than a conventional set up with PMs?	76%	12%	12%
Do you find setting patients up using AlignRT easier than a conventional set up with PMs?	84%	8%	8%

Survey of experience using SGRT.
Table 2 (Blake et al., 2021, p. 63).

SGRT for Lung Cancer

Recent studies reveal encouraging outcomes in use of SGRT for lung cancer patients in reducing errors in positioning compared to traditional methods of setup (Shim et al., 2025).

Various studies reveal SGRT & cone-beam computed tomography (CBCT) can decrease radiation to patients & lower treatment time when used together (Guo et al., 2023).

SGRT for Lung Cancer Cont.

Use of SGRT allows reduction of planning target volume margin of Stereotactic Body Radiation Therapy in lung to be possible (Guo et al., 2023).

For lung cancer patients, SGRT decreases transmission of disease by coughing, due to lack of close contact needed during setup (Blake et al., 2021).

Reproducibility of respiratory motion is enhanced using SGRT, which is important during treatment of thoracic area (Shim et al., 2025).

Study of SGRT for Lung Cancer

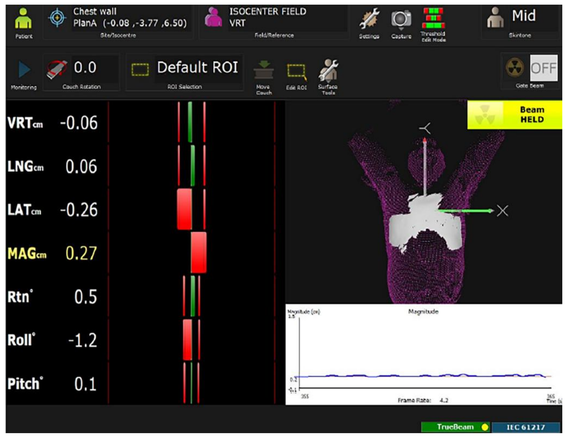
From January to December 2021, 12 lung cancer patients were treated every other day with SGRT & breathing techniques.

AlignRT was used to obtain body surface data with three cameras, comparing errors of six dimensions (vertical, longitudinal, lateral, couch rotation, couch tilt, & couch roll) with reference simulation image.

Results showed errors of dimension less than one millimeter & one degree after SGRT was used, indicating SGRT reduces setup errors.

AlignRT SGRT setup technique allows for high accuracy in setup & decreased intrafraction errors, while allowing displacement errors to be monitored throughout treatment.

(Guo et al., 2023)



Setup of AlignRT SGRT System.
Figure 1 (Guo et al., 2023, p. 4).

SGRT for Breast Cancer

A study of 136 institutions found SGRT was most used for breast treatments, with 85% reporting breast as main application (Batista et al., 2022).

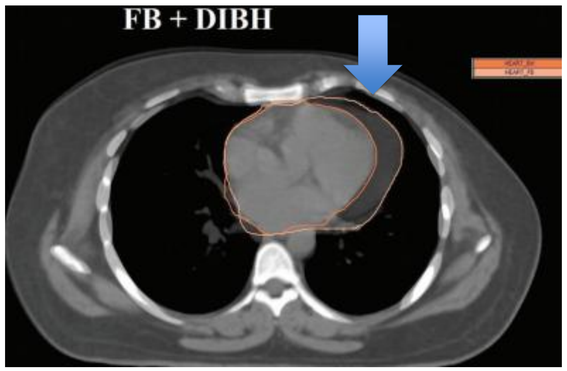
Due to breast tissue being greatly deformable, setup reproduction is difficult. Accurate positioning is vital because errors can lead to inaccurate radiation delivery. (Kang et al., 2023).

SGRT improves breast treatment setup accuracy & effectiveness compared to tattoo/laser method & reduces amount of routine image-guided radiation therapy (Kang et al., 2023).

SGRT uses entire surface of the chest for patient setup, compared to three skin marks used in the laser method, allowing more accurate positioning (Bellala et al., 2023).

Breath hold techniques are used to separate heart & lungs from area of interest by reducing motion.

With DIBH, SGRT continuously monitors patient surface, which reduces dose the heart & lung for breast cancer patients (Bellala et al., 2023).



DIBH reduces area between the heart & lungs & left breast.
Figure 10 (Bellala et al., 2023, p. 1165).

Conclusion:

SGRT is a newly advancing technology that improves the accuracy & safety of radiation therapy treatments. For breast & lung cancer treatments, SGRT monitors motion & decreases radiation to healthy tissue. As technology continues to evolve, SGRT is likely to become common in the radiation therapy field, though further studies are needed to further assess the effectiveness of SGRT.

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