# Researchers improve accuracy of IMRT delivery in post-prostatectomy patients

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Prostate cancer is the most common cancer in men in the United States, as well as the second leading cause of cancer-related deaths in this population. Many of these patients undergo surgical removal of their prostate, followed by radiation therapy applied to their prostate bed — the space where the prostate was once situated.

The most common technique of post-prostatectomy radiation is Intensity Modulated Radiation Therapy (IMRT), in which radiation beams closely conform to the area of interest while sparing normal adjacent healthy structures. To ensure its optimal effectiveness in post-prostatectomy patients, clinicians should precisely deliver the radiation beams to the prostate bed and avoid crucial structures such as the bladder and rectum.

A new study led by researchers at Fox Chase Cancer Center has revealed that a portion of the prostate bed is located outside IMRT treatment margins in a significant percentage of post-prostatectomy patients, suggesting that they may be receiving too little treatment in the appropriate area and too much in surrounding structures during the course of their treatment. This study, the first to examine in detail the location and motion of the prostate bed during IMRT delivery, will be presented by Tracy Klayton, M.D., a senior radiation oncology resident at Fox Chase, at the 53rd Annual Meeting of the American Association for Radiation Oncology on Wednesday, October 5th.

In the study, Klayton and her team localized the prostate bed in 20 post-prostatectomy patients who underwent a total of more than 600 IMRT

sessions at Fox Chase. The researchers used the Calypso 4D Localization System, which involves implanting three radiofrequency transponders, each the size of a grain of rice, in the prostate bed to pinpoint its location at the beginning of daily radiation therapy sessions and to continuously track its movement during the entire setup period and treatment delivery.

During the setup period, the prostate bed was offset from the targeted area of treatment by more than 5 mm in certain directions in about 10-20 percent of the sessions. This displacement resulted in part from movements of the prostate bed that occurred when the bladder and bowel filled up, but the offset was more strongly influenced by the setup uncertainties of the radiation therapy treatment. In nearly one quarter of all sessions, the prostate bed was displaced by more than 1 cm due to these positional uncertainties.

"It is important that the practicing clinician try to minimize setup uncertainties before each treatment," Klayton says. "If the prostate bed hasn't been properly localized, then that day it may not receive the entire prescribed dose."

During treatment, the prostate bed was displaced by more than 5 mm in 90 percent of patients, and in about a third of the sessions. In about three-quarters of the sessions, the prostate bed drifted toward the rectum, possibly as a result of the bladder filling up.

Using the real-time tracking information provided by the Calypso system, the radiation therapists administering each treatment interrupted the treatment to reposition 70 percent of patients, and 15 percent of all treatment sessions. One quarter of the patients were repositioned more than five times during the course of treatment. If the radiation therapists had not carried out these interventions, the prostate bed would have been outside the treatment margins for the remainder of the session in many cases.

"Because the treatment margins used for IMRT are typically so small, if the prostate bed is not localized precisely, part of it could be outside the target dose region a significant fraction of the time, and patients could be getting a higher dose of radiation to an adjacent area instead," Klayton says.

The findings suggest that the Calypso system can help ensure that IMRT is precisely delivered within narrow treatment margins. Currently, many oncologists rely on other methods to align patients for radiation therapy, such as skin tattoos or x-rays of the pelvic bones, rather than the Calypso system or similar techniques that localize the prostate bed directly. In these cases, they should adjust their treatment margins to take into account the displacement of the prostate bed observed before and during treatment delivery, Klayton says.

In the future, Klayton and her collaborators plan to calculate specific treatment margins that clinicians should consider for post-prostatectomy patients receiving IMRT. Future studies should also examine a much larger group of patients over many years to determine how reducing the positional uncertainty of the prostate bed during treatment sessions may improve clinical outcomes, such as tumor control and toxicity to surrounding tissue.

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