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Editorial

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Vero Stereotactic Body Radiation Therapy

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This editorial discusses unique features of the Vero SBRT system equipped for conventional and stereotactic body radiation therapy using a gimbaled photon linear accelerator. This platform most often is used for the treatment of cancer and allows gantry-based treatment facilities to deliver ultramodern therapeutic radiation with sophisticated normal tissue sparing made achievable by first-in-class technology [1].

Figure 1 depicts the all-in-one Vero SBRT system. For treatment, patients typically lie in a supine headfirst position on a robotic tabletop with two-pin knee sponge registry. System geometry comprises a beam central axis for any given radial linear accelerator source position, a lateral axis orthogonal to the beam axis in a transverse plane of the patient, and a superior-inferior patient axis orthogonal to the beam and lateral axes. All axes are coincident at isocenter, with an isocenter accuracy of 0.4-millimeters [1]. A key conceptual Vero SBRT design feature is the notion that once the patient undergoes treatment position localization, the patient is not repositioned manually again. Subsequent patient positioning errors are corrected precisely by robotic tabletop and robotic machine adjustments. The robotic tabletop permits hands-free right-left, up-down, in-out, and pitch angle translations (Figure 1.1). The tabletop is limited currently by no capability of continuous translational motion or hands-free roll corrections. To monitor relatively large patient movements (such as sitting upright, rolling, or cough), an infrared camera may track the position of four (or up-to six) patient body surface markers (Figure 1.2). The market-first concept of mechanical position correction rather than manual patient correction assures greater confidence in precise, safe radiation treatment administration.

To improve normal tissue tolerance of radiation, the Vero SBRT system rotates an O-ring gantry (bore diameter 125-centimeters) up-to ±60-degrees for coplanar and non-coplanar radiation beams (Figure 1.3). Not only does the O-ring gantry pivot allow for unique degrees of freedom in radiation planning, but also the feature promotes specialized high-tech radiation dose mapping for dynamic wave arc therapy. Here, a main thought behind a pivoting O-ring gantry lies with its capacity for non-coplanar radiation beam alignments that lower high radiation dose regions while increasing tolerable low radiation dose regions in normal tissue. Gains in normal tissue sparing by non-coplanar radiation planning may be 4% to 6%, and conceivably higher depending on radiation target and normal tissue spatial geometry. The robotic O-ring gantry pivot has positional accuracy of ±0.5-millimeter overall and ±0.01-millimeter at the beam isocenter (0.06-millimeter wobble). The first-of-its-kind robotic O-ring gantry pivot introduces an ease of coplanar and non-coplanar radiation beam arrangement for normal tissue sparing previously uncommon in radiation therapy planning and treatment.

Lastly, a gimbaled 6MV photon linear accelerator (500 cGy/minute) allows for a quick pan-and-tilt assembly with a range of ±4-centimeters to hone-in on moving radiation targets (Figure 1.4). By design, the beam modulating mechanics of the Vero SBRT platform involve an array of 110-millimeter tall and 5-millimeter wide leaves with small beam side end-curvature and full over-center-travel. The leaves have positional accuracy of ±0.25-millimeters. There are no beam jaws. As a consequence, the radiation beam has a narrow treatment field penumbra (or, peripheral radiation shadow) better for forgiving unwanted normal tissue radiation dose. To all outward appearances, the gimbaled accelerator offers direct line of sight to radiation targets, even those that are moving due to quiet breathing, heartbeat, or other physiologic motion. Gimbaled motion of the accelerator (oscillating speed 0.5 Hz) paired with feedback

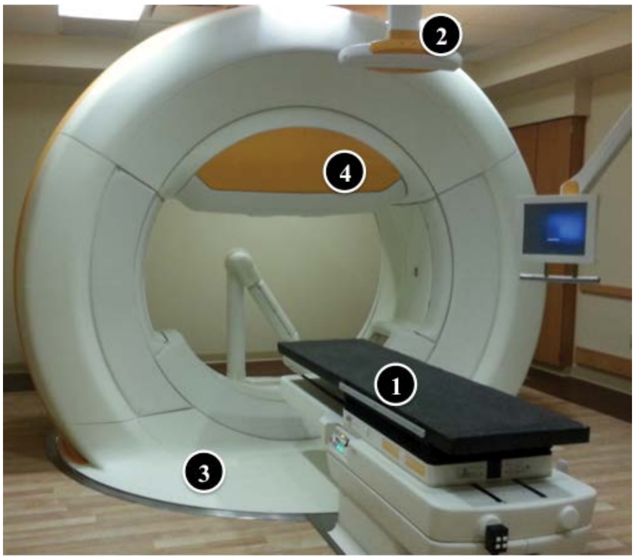

Figure 1: Vero SBRT. (1) Robotic tabletop. (2) Infrared camera. (3) Robotic O-ring gantry. (4) Gimbaled accelerator.

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from dual-diagnostic x-ray units offers real-time target motion management. Positional accuracy of the gimbaled accelerator is ±0.1 millimeters. New-to-the-field Vero SBRT dynamic tracking offers actual in-time motion targeting, reduction in radiation beam portal size, and normal tissue sparing [2]. The gantry for the gimbaled accelerator rotates ±185 degrees, enables multiple static gantry angles or continuous rotational arc therapy, and has a rotational accuracy of ±0.23 millimeters. The practical outcome from these accelerator features is a finely shaped, homogenous radiation dose region with lower likelihood of normal tissue toxicity.

Vero SBRT system radiation treatments are safe and capable of high-level radiation dose avoidance to normal tissues. Clinical research studies on the Vero SBRT system are eagerly awaited and forthcoming.

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