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OPTIMIZED NON-COPLANAR RADIATION DELIVERY FOR SIMPLER, FASTER, AND SAFER TREATMENTS

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Existing LINACs inefficiently deliver non-coplanar beams

The goal of radiation treatment is to precisely deliver a prescribed radiation dose to the targeted tissue, while avoiding dosing the surrounding normal tissues and organs. These treatments require radiation beams to be delivered from multiple coplanar and non-coplanar angles. Currently available linear accelerators (LINACs) deliver non-coplanar radiation doses to targeted areas through by rotating a couch and gantry together—an inefficient process that is susceptible to collision between the machine gantry, couch, and the patient.

Other disadvantages of existing LINAC machines include difficulty in integrating cone beam computed tomography (CT), limitations in locations from which beams can be delivered (e.g., only from above), increased complexity due to moving and/or rotating the entire LINAC head, limitations in the types of treatments possible, and safety concerns.

Non-coplanar delivery with a ring gantry LINAC

This innovative radiosurgery LINAC design provides speed, precision, and simplicity for optimized non-coplanar (4π angles) radiation delivery and six-degree setup correction. It can also be applied to stereoscopic and CT imaging. By delivering a cone-shaped treatment beam using a ring gantry that moves the beam around the patient, the design eliminates the need for a gimbal head and a six-degree robotic couch while maintaining correct rotational setup and providing a beam that is always focused on the virtual isocenter of the patient.

Designed to provide more efficient delivery, the new machine supports dynamic adjustment of the beam intensity and angle as well as the aperture with its multi-layer variable aperture iris collimator. It offers more degrees of freedom than the previous 4π approaches, potentially delivering more conformal doses with a simplified treatment setup. It can be used for both intra- and extra-cranial radiosurgery treatments.

This new design has the potential to offer life-saving curative treatments to patients with a variety of cancers.

Solution Advantages

- **Precise:** Dynamic adjustment of beam intensity, angle, and aperture is designed to enable a treatment plan with superior precision, dose distribution, and delivery efficiency, potentially

reducing radiation to off-target tissues.
- **Robust and versatile:** The machine can treat both intra- and extra-cranial targets, including larger targets, such as the lungs, spine, and liver.
- **Fast:** The ring gantry design enables much faster rotation and operation.
- **Safe:** This design eliminates potential collisions between the patient and the machine while delivering radioisotope-free treatments designed to be safer for both the patient and the facility.
- **Reduced cost:** The machine's smaller size and reduced complexity results in lower manufacturing and maintenance costs. Operational costs are further reduced by lower staffing requirements.
- **Simple:** This design simplifies the planning and delivery of non-coplanar beams, allowing full six-degree correction without using a robotic couch.
- **Extendable:** Additional therapies could be possible from a single machine. A similar approach can be applied to other existing machines (with some limitations).

Potential Applications

- Radiosurgery/3D conformal radiation therapy using LINAC for intra- and extra-cranial radiosurgery, including treatment for prostate, head and neck, or lung tumors
- High-precision imaging, CT, and possibly other types of scanning systems

Patents

Patent has issued: US10632326B2