

CyberKnife® Robotic Radiosurgery System Product Fact Sheet

Overview

The CyberKnife® System is the world's first and only robotic radiosurgery system designed to treat tumors anywhere in the body with sub-millimeter accuracy.

How it Works

Scanning – Prior to treatment with the CyberKnife System, the patient undergoes imaging procedures to determine the size, shape and location of the tumor. The process begins with a standard high-resolution CT scan, or for certain tumors other imaging techniques, such as MRI, angiography or PET, may also be used. The CyberKnife treatment planning software helps integrate CT scans and other imaging data into the pre-treatment planning process.

Planning – Following the scanning, the image data is then digitally transferred to the CyberKnife System's treatment planning workstation, where the treating physician identifies the exact size, shape and location of the tumor to be targeted and the surrounding vital structures to be avoided. A qualified physician and/or radiation oncologist or physicist then uses the CyberKnife software to generate a treatment plan to provide the desired radiation dose to the identified tumor location while avoiding damage to the surrounding healthy tissue. As part of the treatment plan, the CyberKnife System's proprietary planning software automatically determines the number, duration and angles of delivery of the radiation beams.

Treatment – During a CyberKnife procedure, a patient lies comfortably on the treatment table, which automatically positions the patient. Anesthesia is not required, as the procedure is painless and non-invasive. The treatment, which generally lasts between 30 and 90 minutes, typically involves the administration of between 100 and 200 radiation beams delivered from different directions, each lasting from 10 to 15 seconds. Prior to the delivery of each beam of radiation, the CyberKnife System simultaneously takes a pair of X-ray images and compares them to the original CT scan. This image guided approach continually tracks, detects and corrects for any movement of the patient and tumor throughout the treatment to ensure precise targeting. The patient typically leaves the facility immediately upon completion of the procedure.

Follow-up – Follow-up imaging, generally with either CT or MRI, is usually performed in the weeks and months following the treatment to confirm the destruction and eventual elimination of the treated tumor.

Key Advantages

- Treats tumors anywhere in the body
- Continually tracks, detects and corrects for tumor and patient movement throughout the treatment
- Delivers high-dose radiation with sub-millimeter accuracy, minimizing damage to surrounding healthy tissue
- Treats tumors from virtually unlimited directions with flexible robotic mobility
- Extends its radiosurgery benefits to deliver high precision radiation therapy
- Provides an option for patients diagnosed with previously inoperable or surgically complex tumors
- Treats patients in as few as one to five visits
- Improves patients quality of life during and after treatment
 - Non-invasive alternative to surgery
 - Pain free and requires no anesthesia
 - Minimal side effects
 - Outpatient procedure with little or no recovery time
 - Allows for an immediate return to normal activities

Clinical Validation

To date, more than 70,000 patients worldwide have been treated using the CyberKnife System. More than 412 peer-reviewed papers support the CyberKnife System in clinical practice.

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Key Components *Robotic Manipulator and Linear Accelerator-* The compact, 1000 MU/min 6MV X-band linear accelerator is capable of being positioned in virtually any direction by a high precision robotic manipulator with repeatable sub-millimeter accuracy.

Imaging System- The low-energy X-ray sources and the flush mounted detectors create high-resolution anatomical images throughout the treatment and are continually compared to previously generated DRR's to determine real-time patient positioning and target location.

Real-time image-guidance system with continuous target tracking and feedback- Real-time image-guided robotics enables the CyberKnife System to continually track, detect and correct for tumor and patient movement throughout the entire treatment without the need for clinician intervention.

Additional Technologies

Synchrony® Respiratory Tracking System- Continuously synchronizes beam delivery to the motion of the tumor, allowing clinicians to significantly reduce margins while eliminating the need for gating or breath-holding techniques.

RoboCouch® Patient Positioning System- Robotically aligns patients precisely with six degrees of freedom, enabling faster patient setup. The Seated Load option enables simple and comfortable loading of mobility-limited patients.

Xsight® Lung Tracking System- Directly tracks the movement of lung tumors without fiducials while maintaining precision, reliability and self-adjusting repeatability.

Xsight Spine Tracking System- Eliminates the need for surgical implantation of fiducials by using the bony anatomy of the spine to automatically locate and track tumors, making radiosurgery more precise and less invasive.

Xchange® Robotic Collimator Changer- Automatically exchanges collimators robotically, enabling highly conformal treatments delivered with greater efficiency. Synchrony® Respiratory Tracking System.

Iris™ Variable Aperture Collimator

Rapidly manipulates beam geometry to deliver up to 12 beam sizes from each linac position with characteristics virtually identical to that of fixed circular collimators.

InTempo™ Adaptive Imaging System- Intelligent, adaptive imaging system designed from the ground up to address the unique challenges of prostate tracking resulting from random and excessive target motion.

6D Skull Tracking- Rendering invasive stereotactic head-frames obsolete, 6D Skull Tracking uses bony anatomy to continually track intracranial targets and automatically correct for even the slightest translational or rotational shift that might occur during treatment delivery.

MultiPlan® Treatment Planning System- An Intuitive workflow-based application designed specifically for radiosurgery, allowing for the simple and efficient creation of even the most complex treatment plans.

Monte Carlo Dose Calculation- Often considered the gold standard for dose calculation, the CyberKnife System's Monte Carlo Dose Calculation produces results in minutes compared to what commonly requires hours or days with other systems.

Sequential Optimization- An intuitive and intelligent plan optimization algorithm for rapidly developing custom tailored treatment plans specific to the unique clinical objectives for each patient.

AutoSegmentation™- Automatically generate accurate contours for prostate, rectum, bladder, seminal vesicles and femoral heads. Results can be generated using both CT and MR image information, and require minimal user input.

QuickPlan™- A complete treatment plan is generated automatically, and the results presented to the user for review. The entire planning process, including the setting of planning parameters, optimization, and dose calculation, is automated. Plans are generated using the clinical objectives predefined by the user.

4D Treatment Optimization and Planning System- True 4D treatment planning that takes into account not only the movement of the target but also the movement and deformation of the surrounding healthy tissue and critical structures.

MultiPlan® MD Suite- Using MultiPlan MD Suite, a comprehensive set of planning tools for image fusion, contouring and treatment plan review can be remotely accessed by secure connection from outside the clinic.

CyberKnife® Data Management System- Provides comprehensive storage and processing of the patient data that is generated as the patient progresses through the CyberKnife planning and treatment workflow.

Report Administration- The ability to review stored patient and usage data is simple and straightforward with the easy availability of a variety of departmental reports.

Radiosurgery DICOM Interface- This interface utilizes the industry-standard DICOM protocol to export patient treatment plan and delivery information to an Oncology Information System.

Other Resources

CyberKnife Society
www.cksociety.org

CyberKnife Patient Support Group
www.cyberknife.com