

Trilogy Stereotactic System Stereotactic, IMRT, and 3D CRT in one system







STEREOTACTIC, IMRT, AND 3D CRT IN ONE SYSTEM

The Trilogy™ Stereotactic System opens a new chapter in the radiation therapy success story of increasing cancer survival rates. As rapidly improving diagnostic techniques detect cancers earlier, Trilogy makes radiation therapy viable at earlier stages and for more types of disease. Optimized for delivering higher doses to smaller areas over shorter time periods, the Trilogy system represents significant progress toward turning cancer from a terminal disease into a chronic, manageable condition.

Practical as well as visionary, the Trilogy system provides a cost-effective way for radiation oncology departments to expand their treatment repertoire.



With one versatile Trilogy system, treatment facilities can deliver the full spectrum of external beam therapies:

- 3D conformal radiation therapy
- Intensity-modulated radiation therapy
- Electron therapy
- Conformal arc therapy
- Gated radiotherapy
- Image-guided radiation therapy
- Single-session or fractionated stereotactic radiosurgery
- Intensity-modulated radiosurgery

All in one. Best in one. The Trilog^y system is optimized for both conventional and stereotactic treatment approaches.

Highest dose rate

At 1,000 monitor units (MU) per minute, the Trilog^y system delivers a stereotactic dose rate that is 20 percent higher than any comparable system and twice as high as most linacs. A higher dose rate translates into shorter sessions, enabling the treatment of more patients per day.

Tight isocenter alignment—on all three axes

Trilog^y leads in beam accuracy for treating increasingly smaller tumors. On two axes—the gantry and the collimator—Trilog^y's isocenter radius measures 0.5 mm or less. Add the third rotational axis—the table—and the isocenter radius is 0.75 mm or less, the tightest alignment available in a dual-energy system.

Rapid on-board imaging

With Trilog^y's On-Board Imager™ accessory, it's fast and easy to acquire kilovoltage anterior/posterior and lateral images for high-precision repositioning of most patients. Daily online setup corrections typically can be achieved in just a few minutes.

Independently movable robotic arms

Trilog^y's unique On-Board Imager features two independent robotic arms, enabling many image acquisition geometries.

Potential to correct for motion during treatment

Monitoring and correcting for patient motion during treatment is possible using the fluoroscopic mode of Trilog^y's On-Board Imager plus the Real-Time Position Management (RPM™) gating system.

Clear, easy-to-read kV images

Because it's a kilovoltage imaging system, the On-Board Imager produces clear, easy-to-analyze images that result in very low patient doses. And Trilog^y's patented carbon-fiber couch top minimizes distracting artifacts.



Improving treatment precision

Trilogy is the most precise dual-energy delivery system in the world, enabling the treatment of very small lesions in the head and neck as well as deep-seated lesions in the abdomen and pelvis. The beam focal point is a sphere less than 0.75 mm radius, and integrated imaging technology provides precise patient positioning and tumor localization.

Streamlining the stereotactic session

Trilogy streamlines lengthy stereotactic sessions. The high dose rate shortens beam-on time. The remote-controlled couch speeds up treatment delivery and maximizes the number of treatment fields and arcs that can be used.

Maximizing system utilization

Because it's a multipurpose system, Trilogy can pay for itself quickly—often within a few years. While your stereotactic practice builds up, the Trilogy system can be fully utilized delivering IMRT treatments.



Cone-beam CT

With Trilogy's On-Board Imager accessory, cone-beam CT scans (3D CT volumes) can be acquired and used to correct patient positioning based on soft-tissue landmarks. Using sophisticated image analysis tools, the cone-beam CT scans can be compared with reference CT scans to determine how the couch should be moved to fine-tune the setup of the patient.

Treatment planning and delivery without moving the patient

Varian's technology makes it possible to use the Trilogy system to acquire a treatment planning CT scan, create a treatment plan, and deliver the treatment without moving the patient, yielding high accuracy in treatment delivery.

Automated image registration

Patient positioning is fast and precise with Trilogy. Automated image registration algorithms for both anatomy and radiopaque markers instantly compare daily images with reference images.

Remote-controlled couch

Trilogy's remotely controlled couch makes treatment delivery faster and more accurate. Patient setups can be finely tuned from outside the treatment room, with user-definable couch rotation and translation limits. Therapists can also control planned rotations of the couch from outside the treatment room, speeding the delivery of multiple noncoplanar arcs.

Integrated imaging and delivery process

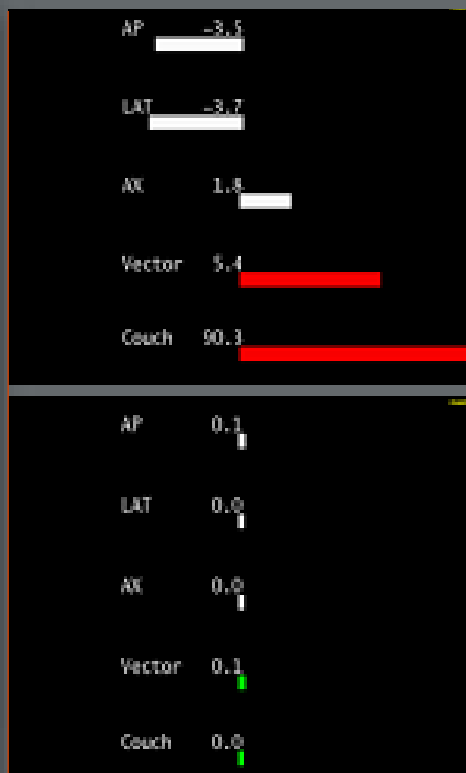
Trilogy integrates imaging and delivery into a single process so well designed that radiation therapists can be proficient from the first day of clinical operation.

Advancing treatment processes

The versatile Trilogy system improves treatment processes for greater efficiency and patient comfort.



Varian's frameless stereotactic immobilization system includes an optically guided bite block. Use of the system makes it possible to reproduce patient setups within 1 to 1.5 mm.



An optical guidance workstation provides the therapist with real-time feedback on patient setup accuracy. As the patient moves into position, long error bars become shorter and change from red to green when the setup is within tolerance.

Frameless intracranial stereotactic radiosurgery with Varian stereotactic components

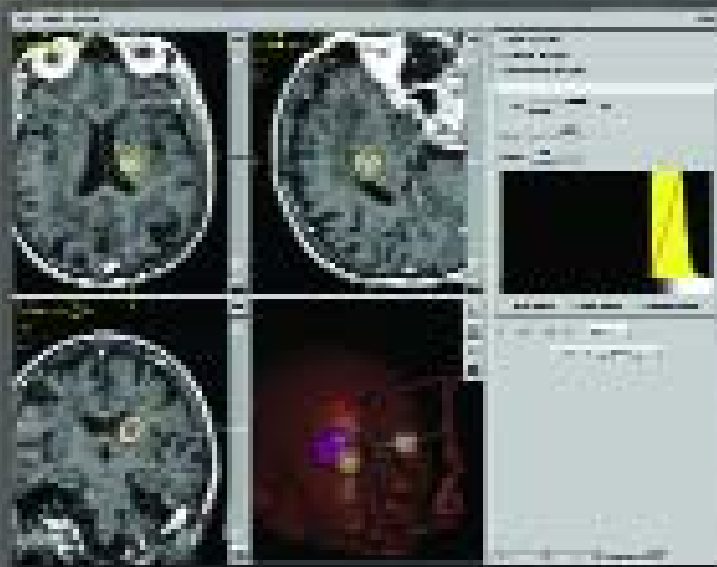
With a multipurpose Trilogy system, you can enhance the flexibility of treatment processes and shorten delivery times while improving the patient's overall comfort level. The following example describes the clinical process for intracranial stereotactic radiosurgery using a Trilogy system with Varian stereotactic components.

STEP 1 | Immobilization Create a custom bite block and head-and-neck immobilization system. The bite block, attached to a fiducial array, enables optical guidance of

patient positioning in the treatment room. Because the immobilization system is frameless, imaging and treatment delivery can be performed on different days, providing scheduling flexibility and improving the patient experience. Frame-based immobilization is also included.

STEP 2 | MR imaging Acquire an MR scan, which is used to define the target volume.

STEP 3 | CT simulation Acquire a treatment planning CT scan, which is used to establish the stereotactic coordinate system.



Trilogy systems with Varian stereotactic components include both MLC-based and cone-based treatment planning software.

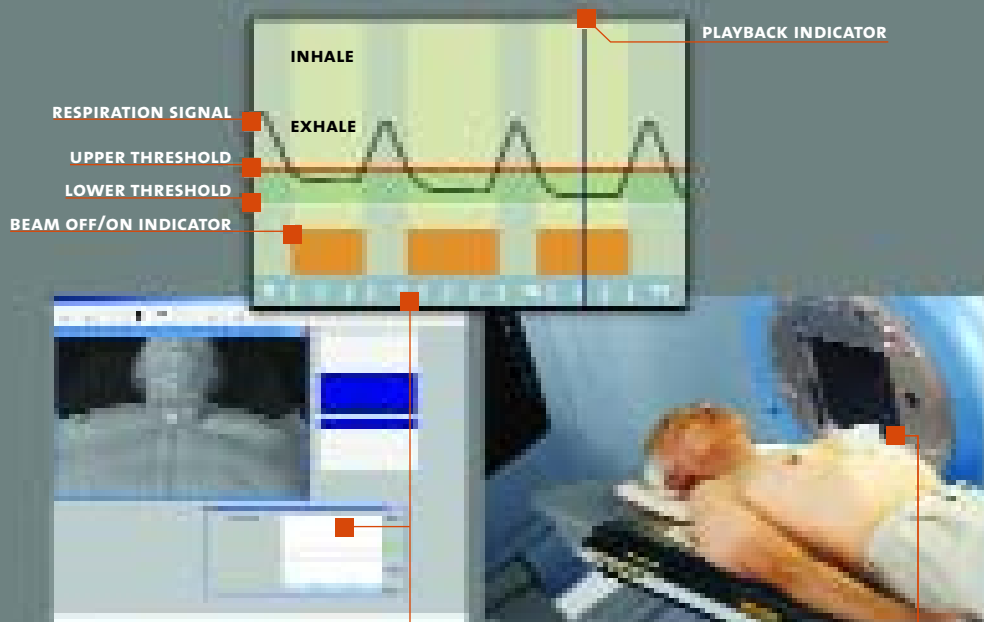
STEP 4 | Treatment planning Use Varian's Stereotactic Image Manager™ software to process the stereotactic CT scan and fuse the MR and CT data sets. Then use Varian's integrated treatment planning system to create MLC-based or cone-based stereotactic treatment plans.

STEP 5 | Patient setup Use advanced optical guidance technology for patient setup. A 3D optical camera detects and monitors the location of fiducial markers on the custom bite block, while a workstation in the treatment room provides therapists with real-time information on setup accuracy.

STEP 6 | Treatment delivery For cone-based treatments, attach the conical collimator to the collimator mount and begin treatment delivery. For MLC-based treatments, use the integrated 120-leaf Millennium™ MLC. After each beam or arc is delivered, remotely rotate the couch to prepare for delivery of the next beam or arc. Remote couch rotation, combined with a stereotactic dose rate of 1,000 MU per minute, can significantly shorten the treatment delivery time.

Advancing treatment processes

The Trilogy system delivers flexibility and confidence in high-precision treatment processes.



At CT simulation, use the RPM gating system to record the patient's reference respiratory waveform. During treatment delivery, the RPM system monitors patient respiration and provides a gating signal to the MV treatment beam, the PortalVision™ aS1000 MV imager, and the On-Board Imager kV imaging system.

The RPM gating system uses a lightweight external marker block to monitor patient respiration. The system is comfortable for patients and flexible enough to support both free-breathing and breath-hold treatment protocols.

Image-guided extracranial radiation therapy with respiratory gating

With the Trilogy system, treatment facilities can deliver the most advanced radiotherapies with precision accuracy, allowing greater confidence in tumor targeting. This example follows the clinical process for image-guided extracranial radiation therapy with respiratory gating.

STEP 1 | Reference waveform acquisition Create the immobilization device and coach the patient for either a free-breathing or breath-hold radiotherapy protocol. Trilogy includes the RPM respiratory gating system, which is used to qualify the patient for gated radiotherapy and acquire a reference respiratory waveform. The reference waveform is saved to the gating database.

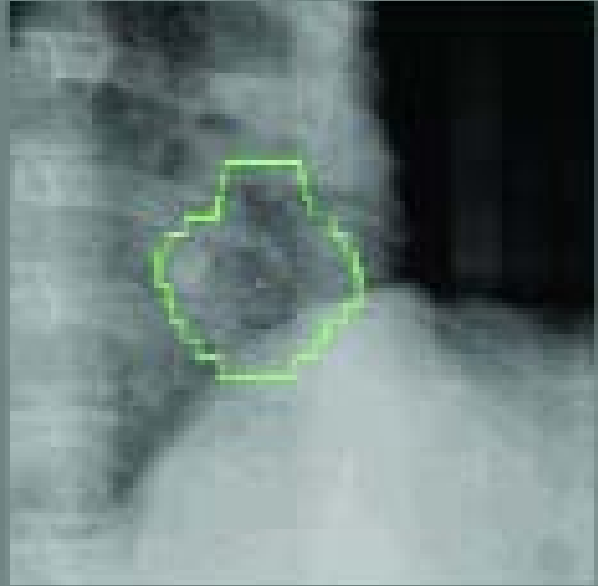
The RPM system supports both free-breathing and breath-hold radiotherapy protocols.

STEP 2 | Gating threshold positioning Position upper and lower thresholds relative to the reference waveform. The RPM gating system is flexible and allows gating at inhalation, exhalation, or any other point in the respiratory cycle. During treatment delivery, the RPM system ensures that the patient's respiration matches the reference waveform and gates the beam on and off, in real time, based on the patient-specific thresholds. Whenever the marker block is within the thresholds, the beam is on; whenever the block is outside of the thresholds, the beam is off.

STEP 3 | CT simulation Acquire a treatment planning CT scan that is gated for respiration. The RPM gating system supports the acquisition of both retrospectively and prospectively gated CT, depending on the capabilities of the CT scanner.



To fine-tune the patient setup, use the On-Board Imager to acquire gated lateral and anterior/posterior radiographs and then compare them to reference images.



Use the fluoroscopic mode of the On-Board Imager to verify gated treatment ports, either before or after treatment delivery. The treatment field aperture is overlaid onto a live kV fluoroscopic image. The aperture is green when the gate is open and red when the gate is closed.

STEP 4 | Treatment planning Use Eclipse™ software to create a gated treatment plan for the 120-leaf Millennium MLC. When gated radiotherapy will be used, a smaller CTV-to-PTV margin is possible, sparing the irradiation of normal tissue immediately surrounding the target.

STEP 5 | Patient setup Position the patient initially using treatment room lasers and then fine-tune the setup using the On-Board Imager for image guidance. To acquire gated anterior/posterior and lateral radiographs, use the RPM system in combination with the On-Board Imager. Automated image analysis can be based on either bony anatomy or radiopaque markers.

STEP 6 | Treatment delivery After the patient setup is fine-tuned, treatment delivery can begin. During treatment delivery, the RPM system monitors the patient's respiration, verifies that it matches the reference respiratory waveform, and gates the beam on and off, based on patient-specific thresholds. Manual image analysis is also available.

STEP 7 | Verification of gated radiotherapy To verify that the patient is set up properly and the RPM gating system is functioning as planned, use the fluoroscopic mode of the On-Board Imager to overlay a treatment field aperture onto live kV fluoroscopy. The live fluoroscopic images can be used to verify that the desired anatomy is within the treatment aperture when the gate is open. Because the kV source is positioned at the MV treatment field's beam's-eye view, this verification step must be performed either before or after treatment delivery with the MV beam.

Trilogy components

The multipurpose Trilogy system includes a full suite of hardware and software components.

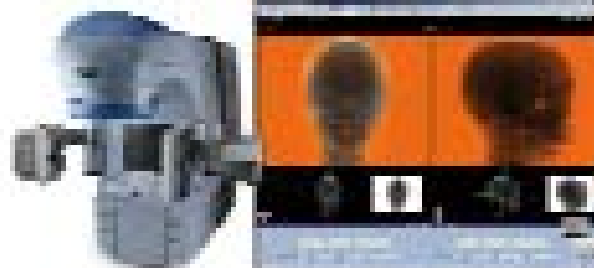
Delivery system

- Trilogy accelerator
- Exact™ couch treatment table
- Millennium MLC with 120 leaves and dynamic MLC software
- RPM respiratory gating motion management system
- LaserGuard™ collision detection system
- 4D Integrated Treatment Console



Image guidance

- On-Board Imager patient positioning and targeting system



Treatment verification and quality assurance

- PortalVision aS1000 electronic portal imaging device with Exact Arm
- Portal Dosimetry IMRT treatment delivery verification software
- Argus™ Linac and Argus IMRT quality assurance software



Stereotactic components

The Trilogy system is compatible with stereotactic components from Varian and other vendors. Varian stereotactic components include:

- Conical collimators for circular arc treatments
- Stereotactic headring, CT localizer, and Couch Mount™ device
- Frameless stereotactic immobilization for intracranial treatments
- Stereotactic treatment planning capability for cones and 120-leaf MLC
- Optical positioning system



TRILOGY ACCELERATOR HIGHLIGHTS

2 photon beams for 3D CRT and IMRT

Energy*	6/10, 6/15, 6/18, or 6/20 MV
Maximum dose rate	600 MU/min
Maximum field size	40 cm x 40 cm

1 photon beam for SRS and SRT

Energy*	6 MV
Maximum dose rate	1,000 MU/min
Maximum field size	15 cm x 15 cm

6 electron beams

Energy*	4/6/9/12/15/18, 6/9/12/15/18/22, 4/6/9/12/16/20 MeV
Maximum dose rate	1,000 MU/min

Isocenter

- ≤ 0.5 mm radius for gantry and collimator axes
- ≤ 0.75 mm radius for gantry, couch, and collimator axes

Remote couch motion

- Corrective, small translations and rotations to fine-tune patient setups
- Planned, large rotations to sequence between noncoplanar arcs

Millennium MLC

Number of leaves	120 leaves
Leaf width	0.5 cm, centralmost 40 pairs 1.0 cm, outermost 20 pairs

On-Board Imager

Radiographic mode	Daily online setup correction based on bony anatomy or radiopaque markers
Fluoroscopic mode	Pretreatment verification of gated treatment ports
Cone-beam CT mode	Daily online setup correction based on soft-tissue anatomy Adaptive radiotherapy

* Energy designations are given according to *British Journal of Radiology Supplement 11 (BJR 11)* definitions.

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Inspiration™ integrated oncology environment.*

Inspiration, the Varian advantage

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