

Comparing CyberKnife and Radiation Therapies

	CyberKnife Radiosurgery	External Beam Radiotherapy (EBRT)		High-Dose-Rate (HDR) Brachytherapy	Low-Dose-Rate (LDR) Brachytherapy (Seed Implant)
		Intensity-Modulated Radiotherapy (IMRT)	Calypso-Guided EBRT/IMRT		
Prior to Treatment					
	Tiny gold markers (fiducials) implanted in a procedure similar to a biopsy	Tiny gold markers (fiducials) may be implanted in a procedure similar to a biopsy	Very small Calypso beacons implanted in a procedure similar to a biopsy	Ultrasound or CT scan performed to determine the prostate size prior to treatment	Ultrasound probe placed in rectum to determine prostate size and shape for pre-implant radiation plan
Treatment Delivery					
Hospital Stay	No hospital stay	No hospital stay	No hospital stay	One or two hospital stays (1 to 2 days each)	No hospital stay
Anesthesia	No anesthesia	No anesthesia	No anesthesia	Spinal or general anesthesia during needle/catheter placement	Spinal or general anesthesia during needle/seed placement
Method of delivering radiation	Concentrates 150-200 beams of radiation on prostate from numerous angles and locations	Aims 5-7 beams of radiation at prostate from a single arc	Aims 5-7 beams of radiation at prostate from a single arc	15-20 small tubes (catheters) are inserted into the prostate to be used to deliver radiation	20 or more needles inserted into the prostate permanently deposit about 100 radioactive seeds, which then release radiation over a period of time
Method of targeting/tracking	Robot automatically locates fiducials	Patient's skin is marked and therapist aligns on those marks, or targets fiducials using X-ray images	Radio-frequency detector determines beacon location. Therapist manually adjusts treatment table accordingly	Ultrasound probe placed in rectum visualizes prostate and needle/catheter position	Ultrasound probe placed in rectum visualizes prostate and needle/seed position
Correcting for movement	Throughout treatment robot automatically adjusts for any movement or rotation	Technician manually adjusts prior to each treatment session; no real-time correction for any movement or rotation during treatment	If movement exceeds error threshold (3 mm), treatment stops and technician manually adjusts treatment table; no correction for rotation	Physician manually places catheters using ultrasound images for guidance; a customized treatment plan accounts for variation in catheter position	Physician manually places needles using ultrasound images for guidance; no corrections possible after seeds have been implanted
Accuracy	One-millimeter accuracy protects surrounding tissues	Target area is expanded to include the prostate plus 5-10 millimeters to account for uncertainty	Target area is expanded to include the prostate plus approximately 5 millimeters to account for uncertainty	Custom radiation plan delivers radiation dose to within 2-3 millimeters of the target, which spares surrounding tissues	Seeds positioned with 3-5 millimeters accuracy; occasionally some seeds migrate to the lung(s)
Biologically equivalent radiation dose	200 Gy (units of radiation)	150-160 Gy (units of radiation)	150-160 Gy (units of radiation)	170-220 Gy (units of radiation)	170-210 Gy (units of radiation)
Number/Length of Treatments	1 treatment daily for 5 days	1 treatment daily for 8-9 weeks	1 treatment daily for 8-9 weeks	1- to 2-day hospital stay, plus 5 weeks of external beam radiation therapy; or two implants with 1- to 2-day hospital stay each	Single outpatient procedure; additional 5 weeks of external beam radiation therapy may be required
Recovery/Side Effects					
Side effects during/after treatment	Mild to moderate urinary problems and mild fatigue for 1-2 months; about 1% of patients need catheterization for urinary retention; resume normal activity immediately after treatment	Mild urinary and bowel problems and mild fatigue for 2 months; need for catheterization for urinary retention is rare; resume normal activity immediately after treatment	Mild urinary and bowel problems and mild fatigue for 2 months; need for catheterization for urinary retention is rare; resume normal activity immediately after treatment	Mild pain from catheters; moderate urinary problems and fatigue for 1-2 months; about 3% of patients need catheterization for urinary retention; resume normal activity 1-2 days after leaving the hospital	Pain at needle insertions; mild to severe urinary symptoms for 1-3 months; brief, mild fatigue; about 8% of patients need catheterization of urinary retention; resume normal activity day after implant
Long-term side effects	Despite receiving a dose similar to brachytherapy, long-term urinary effects are not common and rectal injury is rare; 20-30% patients develop erectile dysfunction	Long-term urinary and rectal injury is not common; approximately 1/3 of patients develop erectile dysfunction	Long-term urinary and rectal injury is not common; approximately 1/3 of patients develop erectile dysfunction	Occasional long-term urinary effects; rectal injury is rare; approximately 1/3 of patients develop erectile dysfunction	Frequent long-term urinary effects; rectal injury is not common; approximately 1/3 of patients develop erectile dysfunction
Outcomes (cancer-control rates/freedom from PSA rise)					
	Research at the Seattle Cyberknife Center and elsewhere are showing excellent PSA responses and low rates of recurrence. Longer follow-up is needed to confirm these findings.	10+ year cancer-control outcomes inferior to brachytherapy; increasing the dose using image-guidance may improve results.	10+ year cancer-control outcomes inferior to brachytherapy; increasing the dose using image-guidance Calypso may improve results.	Excellent cancer-control rates with 5-10 year follow-up	Excellent cancer control rates with 10-15 year follow-up