GYROSCOPIC RADIOSURGERY

A Comparative Guide to SRS Delivery

	ZAP-X® GYROSCOPIC RADIOSURGERY™	COBALT-60 RADIOSURGERY	CONVENTIONAL & ROBOTIC RADIOSURGERY
Shielding & Vault Requirements	**Fully integrated, independent shielding system.** In most settings, eliminates the need for costly radiation vaults. **ZAP-X** makes it feasible for simple point-of-care installation at virtually any location, including satellite facilities, physician offices and outpatient surgery centers.	**Requires costly shielded treatment vault in all instances.** **Necessitates significant security infrastructure.**	**Requires costly shielded treatment vault in all instances.**
Clinical Applications	- **Primary/Metastatic Brain Tumors** - **Functional Disease (e.g. trigeminal neuralgia)** - **Vascular Disease (e.g. AVM)** - **Head & Neck** **ZAP-X** is dedicated to safe and efficient radiosurgery delivery without the overhead of full-body complexity.	- **Primary/Metastatic Brain Tumors** - **Functional Disease (e.g. trigeminal neuralgia)** - **Vascular Disease (e.g. AVM)** - **Head & Neck**	- **Anywhere in the body** Full-body application adds complexity, elevating the need for significant staffing, rigorous training, and resource-intensive Q.A. Related complexities may introduce additional risks of mechanical and human error.
Immobilization	**Frameless, non-invasive thermoplastic mask immobilization.** **ZAP-X** enables simple fractionation when clinically indicated. Frameless scan-plan-treat workflow can be broken into independent steps, enabling brief patient-friendly outpatient visits.	**Primarily invasive stereotactic frame immobilization.** Contiguous scan-plan-treat workflow requires full-day, on-site patient care. Optional frameless capability available for some indications.	**Primarily thermoplastic mask immobilization.** May accommodate rigid stereotactic frames for some indications.
Target Localization	**3D patient registration achieved via an integrated planar kilovolt (kV) imaging system.** **ZAP-X** provides image guidance with automated re-alignment both prior to and throughout each radiosurgical treatment.	**Mechanical triangulation via rigid stereotactic frame.** In most cases, provides no intra-fraction image guidance. Potential target shifts likely to remain undetected, which may result in exposure to surrounding healthy structures.	*Conventional Radiosurgery:* **Provides cone-beam CT setup image guidance; standard configuration does not provide intra-fraction target imaging or guidance.** *Robotic Radiosurgery:* **Provides continual intra-fraction kV image guidance and automated re-alignment throughout each treatment.**
Treatment Delivery	*Source:* **1500 MU/min linear accelerator.** *Energy:* **3MV** – Provides optimal dose coverage for intracranial targets while minimizing whole brain dose; sharpens steep dose gradient necessary for SRS. *Source Axis Distance (SAD):* **45cm** – Reduces geometric beam penumbra, sharpens steep dose gradient necessary for SRS. **ZAP-X** tailors all aspects of beam delivery to the unique requirements of cranial radiosurgery.	*Source:* **192 cobalt-60 radioactive sources.** Dose rate ~300MU/min maximum, depending on source age. Sources must be replaced approximately every 5 years. Requires heavy regulation, bureaucratic licensing and continuous heightened security burden. *Energy:* **~4MV (effective equivalent).** *Source Axis Distance (SAD):* **~40-60cm (varies based on model, source sectors used).**	*Source:* **1000-2400 MU/min linear accelerator.** *Energy:* **6-10MV** - Higher energy pushes dose gradient away from the target. May result in additional exposure to surrounding healthy structures. *Source Axis Distance (SAD):* **80-100cm** - Larger SAD degrades geometric beam penumbra, pushing dose gradient away from the target.
Beam Collimation	**8 automated spherical collimators (4mm-25mm).** Tungsten-encased collimator lowers radiation leakage to less than 0.01% of the primary radiation beam. **ZAP-X** provides significant reduction in peripheral patient dose as compared to conventional and robotic radiosurgery systems.	**Automated 4, 8, and 16mm cones.**	*Conventional Radiosurgery:* **Multi-leaf collimator or optional 7 spherical cones (4mm-17.5mm).** *Robotic Radiosurgery:* **Multi-leaf collimator or optional 12 spherical cones (5mm-60mm).**
Dosimetry Validation	**Factory commissioned MV image detector provides a real-time, independently calibrated check of the administered dose.** **ZAP-X** employs a novel fail-safe mechanism for mitigating the risks of potential mechanical and human error.	**No real-time or offline dosimetry capabilities.**	*Conventional Radiosurgery:* **Optional electronic portal imaging devices (EPID) require complex commissioning and may provide limited offline dosimetry capabilities.** Such subsystems have seen very limited clinical acceptance to date. *Robotic Radiosurgery:* **No real-time or offline dosimetry capabilities.**

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