



TECHNICAL OVERVIEW OF GAMMA KNIFE RADIOSURGERY

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- The Gamma Knife (GK) technology is for stereotactic radiosurgery (SRS).
- In 1951 Lars Leksell invented stereotactic fixation frame to target beam of radiation into human brain using polar coordinates.
- In 1967 first Gamma Knife prototype.

Leksell Gamma Knife Model U (A)

- 201 Cobalt-60 sources in a hemispheric configuration.
- For precise and efficient intracranial radiosurgery.
- Stereotactic frame is attached to patient's head, external collimator helmet.
- Model U (A) with computer dose planning system.



Fig. 1. Leksell Gamma Knife Model U (A)

- Leksell Gamma Knife Model B in 1987.
- Spherical sources configuration.
- Internal and external (4, 8, 14, 18 mm) collimators.
- Dose rate 3.0 Gy/min.
- Treatment range
100/120/150 mm in X/Y/Z.
- 0.50 mm radiological
accuracy.



Fig. 2. Leksell Gamma Knife Model B

Leksell Gamma Knife Model C, 4C

- Introduced in 1999 with automatic positioning system (APS).
- Treatment range in z axis 150→165 mm.
- Updated 4C model in 2005.
- Improved APS system.
- Leksell GammaPlan® software.



Fig. 3. Leksell Gamma Knife Model 4C

- Introduced in 2006.
- 192 Co-60 sources divided into 8 sectors.
- 120 mm tungsten collimator array ring.
- 4 positions for collimator size of 4, 8, 16 mm, blocked.

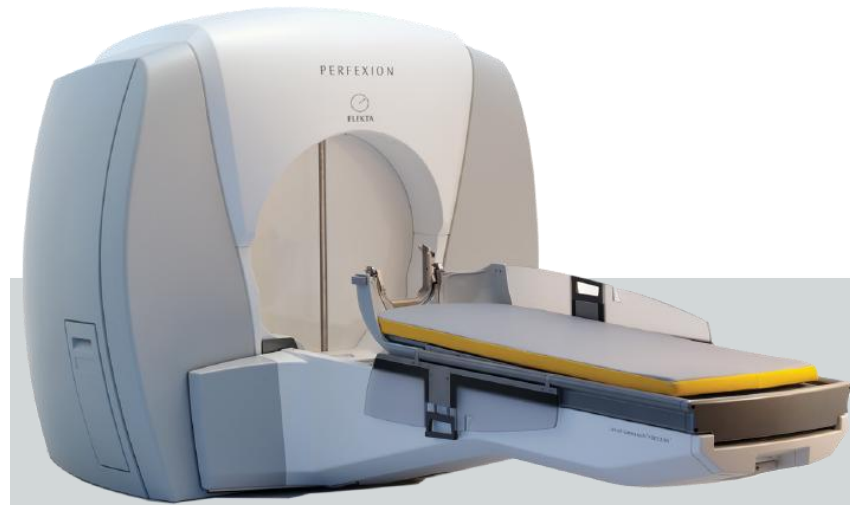
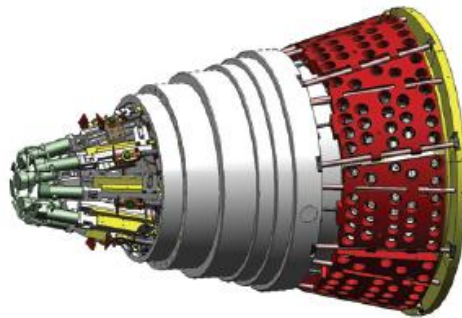
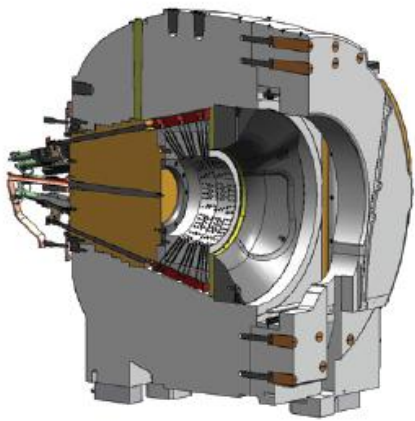


Fig. 4. Perfexion radiation unit

Fig. 5. Leksell Gamma Knife Perfexion

- Treatment range is 180/180/220 mm.
- Patient Positioning System PPS.
- Radiological accuracy up to 0.25 mm.

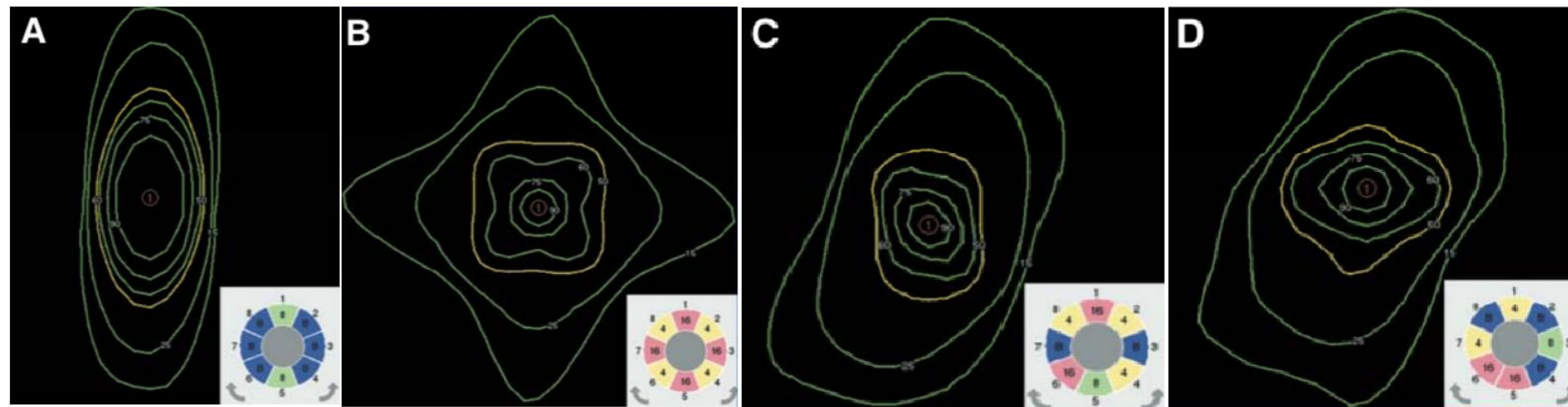


Fig. 6. Example of composite shots for dynamic dose shaping

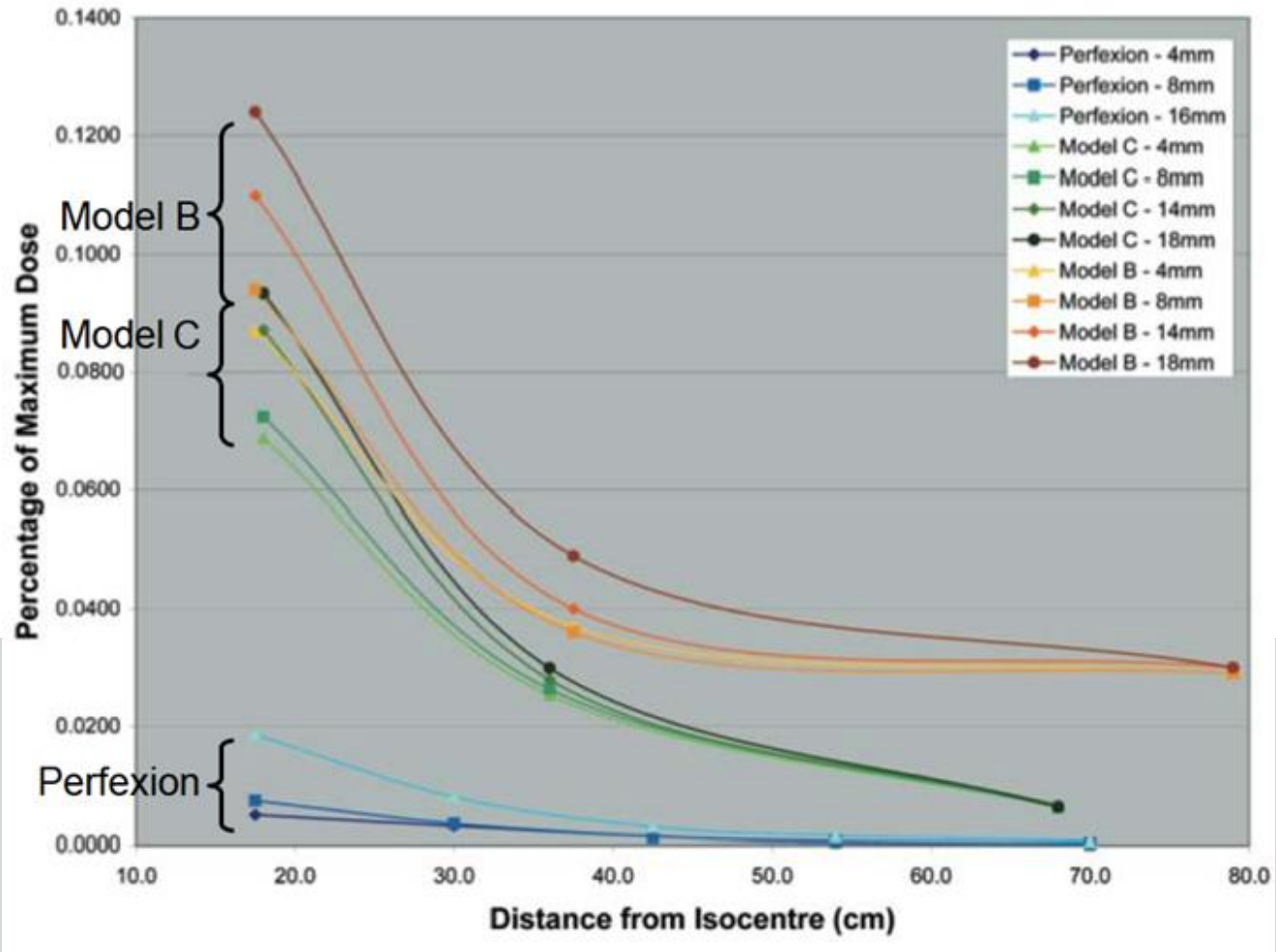


Fig. 7. Body dose compared between GK models

- GK Icon designed in 2015.
- CBCT and high definition motion management (HDMM).
- Frameless, thermoplastic mask fixation based stereotactic radiosurgery.
- Adaptive re-planning fractionated stereotactic radiotherapy.
- Radiological accuracy > 0.15 mm.



Fig. 8. Leksell Gamma Knife Icon

- Improvements in stereotactic radiosurgery technologies.
- Newest Gamma Knife radiosurgery offers frame or frameless real-time motion management, adaptive radiotherapy
- New software enables to compare dose distribution that is about to deliver to the planned dose.
- 2018 Gamma Knife Icon in Kaunas Clinics.