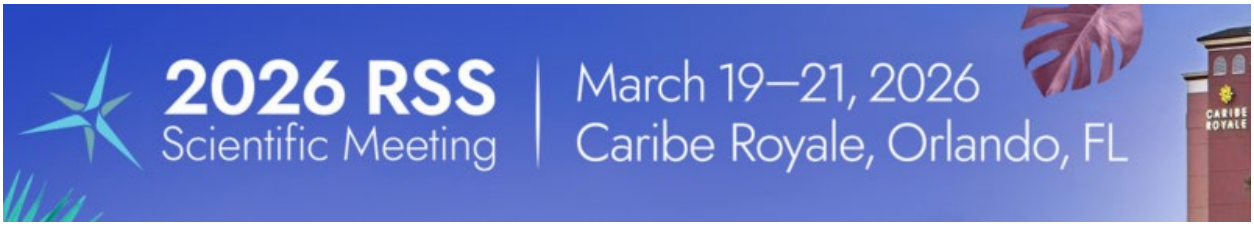

Thinking Outside the Box: Customizing Frame and Mask Systems for Challenging Anatomies in Complex Gamma Knife Radiosurgery

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Objectives: To describe two innovative fixation adaptations for Gamma Knife radiosurgery (GKRS) that address unique anatomical and technical challenges—one preserving a vascularized scalp flap and another enabling extracranial target immobilization for a low-positioned vagal schwannoma.

Methods: Two patients underwent individualized GKRS treatments at a tertiary radiosurgery center.

Case 1: An 81-year-old man with pleomorphic dermal sarcoma involving a scalp flap was treated with a customized half-mask system with lateral cutouts to prevent flap compression. High-definition motion management (HDMM) was used to monitor intrafraction stability.

Case 2: A 62-year-old man with a 1.5 cm right carotid space vagal schwannoma was treated using a novel hybrid fixation combining a stereotactic G-frame and a modified thermoplastic mask, joined via a custom 3D-printed adaptor to restrict mandibular motion and allow inferior target access.

Results: In both cases, immobilization was secure and treatment delivery was precise. The modified half-mask achieved < 1.5 mm motion tolerance, preserving flap viability and avoiding additional imaging or replanning. The hybrid fixation provided stable jaw restriction, enabling complete target coverage (96%) with acceptable conformity and dose gradients. Both treatments were completed safely, with excellent patient tolerance and no acute complications.

Conclusion(s): Personalized fixation strategies can expand the clinical reach of GKRS to anatomically complex or extracranial targets while maintaining precision and patient safety. These cases demonstrate that thoughtful integration of frame- and mask-based immobilization—supported by real-time motion management and custom hardware—allows radiosurgeons to tailor treatment to each patient's anatomy, preserving the principles of accuracy and comfort central to radiosurgical care.