17TH INTERNATIONAL STEREOTACTIC RADIOSURGERY SOCIETY CONGRESS

ISRS 2026

SYDNEY, AUSTRALIA

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ABSTRACT E-BOOK

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ORAL PRESENTATION
ABSTRACTS

OP-001

ORAL PRESENTATION - INTRACRANIAL QUALITY ASSURANCE AND DOSIMETRY
01-06-2026 11:30 - 12:30

MICROBEAM RADIATION THERAPY: THERAPEUTIC ADVANTAGES AND TECHNOLOGICAL CHALLENGES

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Spatially fractionated radiation therapy (SFRT) deliberately introduces spatial modulation of the radiation dose within the target volume and surrounding organs at risk, in contrast to conventional homogeneous dose delivery [1]. Originating in the early 20th century, SFRT has re-emerged as a promising paradigm in radiation oncology, challenging traditional treatment concepts by exploiting the dose-volume effect [2,3] an improved treatment efficacy combined to reduced side effects.
The development of third-generation synchrotron radiation sources has enabled the production of highly collimated, high dose-rate X-ray microbeams and minibeams as a form of SFRT. Microbeam and minibeam radiation therapy (MRT), defined by beam widths below 100 μm [1] and spacing between 100 μm and 1 mm [4], respectively, have demonstrated remarkable outcomes in preclinical studies. MRT significantly broadens the therapeutic window, achieving superior tumour control in radioresistant malignancies while simultaneously reducing normal tissue toxicity compared with conventional radiotherapy [5].
MRT effectiveness is commonly quantified against the peak-to-valley dose ratio (PVDR), a key physical parameter describing the dose gradient required to achieve specific radiobiological effects. However, the relatively low X-ray energies required to confine dose deposition in tissue, combined with the extreme spatial fractionation, pose substantial challenges for accurate PVDR measurement. Simultaneous dosimetry of the peaks and valleys demands micron-scale spatial resolution, a dynamic range spanning several orders of magnitude, and high sensitivity for reliable valley dose detection.
This work presents an overview of the status of global preclinical MRT research on radiobiology and treatment planning, together with the most advanced technologies proposed for quality assurance and dosimetric characterization of this technically demanding and highly promising radiotherapy modality.

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[2] Matthias Sammer et al. Beam size limit for pencil minibeam radiotherapy determined from side effects in an in-vivo mouse ear model, 2019, PLOS.One doi.org/10.1371/journal.pone.0221454
[3] Narayani Subramanian et al. Superior Anti-Tumor Response After Microbeam and Minibeam Radiation Therapy in a Lung Cancer Mouse Model, 2025, Cancers 17
[4] Pierre Deman et al. Monochromatic minibeams radiotherapy: from healthy tissue-sparing effect studies toward first experimental glioma bearing rats therapy, 2012, Int J Radiat Oncol Biol Phys, doi: 10.1016/j.ijrobp.2011.09.013
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OP-002

ORAL PRESENTATION - INTRACRANIAL QUALITY ASSURANCE AND DOSIMETRY
01-06-2026 11:30 - 12:30

MULTI-INSTITUTIONAL FILM DOSIMETRY AUDIT IN MULTI-FOCAL SRS: VARIABILITY IN GAMMA PERFORMANCE AND PLAN QUALITY ACROSS CENTERS, TREATMENT MODALITIES, AND TREATMENT PLANNING SYSTEMS

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Purpose:
Recent multi-institutional studies have shown substantial variability in SRS plan quality and delivery accuracy, underscoring the need for external audits to identify practice-dependent differences. This study assessed inter-institutional variability in gamma performance for a standardized SRS multi-focal case and examined whether results differed by treatment platform or correlated with plan quality metrics.

Materials and Methods: Twenty-seven centers including Gamma Knife and different linac modalities participated in a film-based external audit using an identical multiple target structure set and prescription. Gamma passing rates (GPR) under 5%/1mm (global) and 3%/2mm (local) criteria were collected for all centers. A subset of 17 centers also reported gradient index (GI) and Paddick conformity index (PCI) metrics. Four centers underwent repeated irradiations due to initially unacceptable GPRs. Kruskal–Wallis tests were used to compare GPR across modalities and treatment planning systems (TPS) groups. Spearman coefficients quantified associations between GPR and PCI/GI. Distributional characteristics, including the first quartile (Q1), evaluated performance consistency.

Results:
A total of 92% of the participating centers exceeded the 90% threshold (5%/1mm) with a median GPR of 97.6%. Four initially failing centers improved their GPR after repeated irradiation. Correlation analysis demonstrated no strong association between PCI or GI and GPR. Median GPR did not differ significantly across modality or TPS categories ($p>0.05$), indicating comparable central performance between platforms. However, lower-tail performance varied markedly. Q1 values ranged from 80.5-94.3% across modalities and from 84.5-94.2% across TPSs, revealing differences in consistency despite comparable medians.

Conclusion:
Plan-level dosimetric metrics were not associated with GPR, and median gamma performance did not

differ significantly between units or TPSs. These results suggest that inter-institutional differences arise primarily from local implementation and delivery practices rather than from the choice of platform, reinforcing the role of independent end-to-end audits in detecting actionable variability across centers in SRS practice.

OP-003

ORAL PRESENTATION - INTRACRANIAL PEDIATRICS AND OCULAR
01-06-2026 11:30 - 12:30

PATTERNS OF CARE AND OUTCOMES OF STEREOTACTIC RADIOSURGERY FOR RADIATION-INDUCED MENINGIOMAS: A SINGLE-INSTITUTION COHORT ANALYSIS

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Introduction: Radiation-induced meningiomas (RIMs) are a late sequela of cranial irradiation and frequently present with multiplicity, atypical histology, and challenging anatomic locations. Stereotactic radiosurgery (SRS) and stereotactic radiotherapy (SRT) provide options for local control in previously irradiated patients, yet long-term outcomes remain incompletely characterized.

Methods: We retrospectively reviewed all patients with RIM treated at our institution from 2005–2022. Inclusion required prior cranial irradiation for a non-meningioma diagnosis. Patients were stratified by management strategy (SRS vs non-SRS). Clinical features, histology, lesion location, and outcomes were examined. Kaplan–Meier methods estimated lesion-level local control (LC) and overall survival (OS). A random-effects meta-analysis of published series through 2024 was performed to contextualize institutional results.

Results: Among **33 patients with 50 lesions, 9 patients (25 lesions)** underwent SRS, while 24 patients (25 lesions) were managed with surgery, EBRT, or observation. SRS was preferentially used in older survivors (median age **40 years,** range 25–54), post-operative cavities (odds ratio = 13.7), skull base lesions (odds ratio = 7.9), and atypical histologies (28% WHO II vs none in the non-SRS group). Median SRS margin dose was 15 Gy (13–15). At a median follow-up of **61 months**, 1- and 5-year LC were **92% and 76%** respectively. Failures occurred in 20% of lesions, including three cavities. WHO II lesions had higher failure (43%) compared with WHO grade I (11%). SRS was well tolerated, with no acute grade ≥3 toxicity and one delayed cyst requiring resection. Pooled analysis of six published SRS/SRT series (162 patients, 247 lesions) demonstrated 5-year LC = 79% (95% CI 71–86) and PFS = 83% (95% CI 72–92). Incorporation of our data modestly increased the pooled LC to ~80% and reduced heterogeneity (I^2 = 48%).

Conclusions: SRS and SRT achieve durable long-term control for radiation-induced meningiomas and latency intervals, with low toxicity despite prior irradiation. Outcomes are comparable to those reported for sporadic meningiomas.

OP-004

ORAL PRESENTATION - INTRACRANIAL PEDIATRICS AND OCULAR
01-06-2026 11:30 - 12:30

GAMMA KNIFE FOR RESIDUAL VEIN OF GALEN MALFORMATIONS IN CHILDREN: THE GREAT ORMOND STREET AND QUEEN SQUARE EXPERIENCE.

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Introduction: Vein of Galen Malformations (VOGM) are extremely rare but potentially lethal congenital high flow intracranial arteriovenous shunts. Standard treatment is endovascular, often in early infancy. After life-saving endovascular treatment some children are left with smaller but still open AV shunts. Gamma Knife (GK) stereotactic radiosurgery may have a role in treating residual VOGM.

Methods: Retrospective chart and radiology review of all children with residual VOGM treated with GK at our combined quaternary referral centre from 2017-2025.

Results: We identified 10 children treated during the study period (6 boys and 4 girls). 1 child was diagnosed antenatally, the mean age at postnatal diagnosis of the lesion was 3 years with the latest presentation at age 7. All children had initially been treated with endovascular embolisations (minimum of 2 previous treatments) and had residual AV shunting. The mean age at GK treatment was 10.8 years (range 7.4-16.5 years). Contouring and dose planning was undertaken in a multidisciplinary manner between a paediatric neurosurgeon, adult neurosurgeon (both with radiosurgery training), paediatric neuro-interventionalist (with experience of endovascular VOGM treatment) and medical physicist. Of the 6 children with 36 months follow up, 4 (60%) have been cured, whilst for the 4 children with ≥ 60 months follow up, 4 (100%) have been cured. There were 2 temporary adverse events – 1 child had acute thrombosis of the draining vein requiring 3 months anticoagulation, and 1 child had delayed tectal oedema causing papilloedema which required oral steroids. There was no permanent neurological morbidity or mortality in this series.

Conclusion: In a centre with a specialized pediatric neurovascular multidisciplinary team working in conjunction with experienced radiosurgeons and physicists, GK is a safe and effective treatment for residual VOGM.

OP-005

ORAL PRESENTATION - INTRACRANIAL PEDIATRICS AND OCULAR
01-06-2026 11:30 - 12:30

STEREOTACTIC RADIOSURGERY, BRACHYTHERAPY OR ENUCLEATION FOR UVEAL MELANOMA: COMPARISON OF OUTCOMES IN COMPARABLE GROUPS

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Data concerning comparison of outcomes of stereotactic radiosurgery (SRS), Ru-106 brachytherapy (BT), and enucleation (En) for uveal melanoma (UM) in comparable groups are very limited.

Purpose. To compare the effectiveness and survival of patients with UM treated with SRS, BT, or En in comparable groups.

Methods. The records of 676 UM patients (676 eyes) were reviewed. One hundred forty patients were treated with SRS (101 patients using Gamma-Knife, 40 patients using CyberKnife), 346 with BT, 190 with En. SRS group of patients was compared with the group of those who underwent enucleation only according to survival. The comparison of SRS group with BT group was carried out in terms of tumor control, the number and types of complications, eye preservation, and survival. All groups had no statistical differences in tumor size, ciliary body involvement, and localization ($p>0.1$).

Results. Five-year survival rates of patients treated with SRS (91%) or enucleation (82%) had no statistical difference ($p=0.095$). The same data were obtained comparing SRS group (92%) with BT group (85%) ($p=0.9$). There was no difference in tumor regression degree in patients underwent SRS and BT ($p=0.45$): complete regression 23% vs 28%, partial regression 74% vs 63% and tumor growth 3% vs 7%. Eye retention rates were also equal for BT (94%) and for SRS (95%) in 5-year follow-up ($p=0.49$). Number of complications in both groups had not statistical significance ($p=0,11$), and included radiation retinopathy (SRS 37%, BT 15%), neuro-retinopathy (SRS 9%, BT 12%), vitreous hemorrhage (SRS 3%, BT 4%), secondary glaucoma (SRS 6%, BT 7.5%).

Conclusion. The survival rate of patients with UM is similar after SRS, BT, or enucleation. The number of complications of SRS does not exceed that of BT. It is possible to save the same number of eyes with UM using SRS or BT.

OP-006

ORAL PRESENTATION - INTRACRANIAL PEDIATRICS AND OCULAR
01-06-2026 11:30 - 12:30

HYPOFRACTIONATED STEREOTACTIC RADIOTHERAPY FOR UVEAL MELANOMA

Isa Bossi Zanetti[1], Marco Pellegrini[2], Giancarlo Beltramo[1], Achille Bergantin[1], Anna Martinotti[1], Irene Redaelli[1], Chiara Spadavecchia[1], Deborah Fazzini[1], Giovanni Staurenghi[2]
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AIM: We report our clinical experience of a hypofractionated Cyberknife radiotherapy treatment for uveal melanoma (UM).

MATERIALS AND METHODS: We retrospectively evaluated 68 pts, treated by Cyberknife between April 2014 and January 2024 for UM. Radiotherapy was performed delivering a mean total dose of 56 Gy in mean 3 fractions of mean 18 Gy prescribed to a mean 81% isodose surface. All pts underwent orbit MRI with gadolinium (1 mm thickness) for coregistration with the planning CT scans and were irradiated eyelids closed, with a bandage on it, using a contention with a thermo-plastic mask. For 21 patients (30.9%) tantalium markers were used. The PTV included the contrast-enhancing lesion on MRI (GTV = CTV) plus 2.5 mm margins in all directions.

RESULTS: After a mean follow-up of 46.5 months (range 12 – 112) local control was achieved in the 100% of pts, 9 (13.2%) developed distant metastases and 6 (8.8%) died. The mean thickness decreased substantially, from 4.9 mm (±2.1 mm) to 2.5 mm (±1.7 mm), with an average decrease of 2.4 mm. A significant improvement in retinal detachment was observed: it was present in 63 pts (93%) at diagnosis, then detected in only 13 cases (19%). The most common side effects were radiation retinopathy reported in 42 pts (61.8%), cataract in 30 (44.1%), cystoid macular edema in 20 (29.4%) and radiation neuropathy in 17 pts (25%). 3 pts (4.4%) suffered of retinal detachment and 8 (11.8%) of neovascular glaucoma which required enucleation in 4 pts (5.9%). To reduce toxicity intravitreal anti-VEGF (+/- photodynamic therapy) were performed.

CONCLUSION: Our results are consistent with data in literature and show a safe, minimally invasive, and well tolerated method for treating UM. The main limitation is that it is a retrospective study. Continued accrual and follow-up are required to confirm long term results.

OP-007

ORAL PRESENTATION - INTRACRANIAL YOUNG INVESTIGATOR SESSION
01-06-2026 15:45 - 16:45

INDUCTION STEREOTACTIC RADIOSURGERY REMODELS THE GLIOBLASTOMA IMMUNE MICROENVIRONMENT VIA CALRETICULIN-MEDIATED IMMUNOGENIC CELL DEATH: A TRANSLATIONAL PROOF-OF-CONCEPT STUDY

Yun Guan[1], Xing Di[1], Jiawen Chen[2], Xin Wang[1], Huaguang Zhu[1], Zhiyong Qin[1], Enmin Wang[1]
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Objectives: High-grade gliomas (HGG) exhibit an immunosuppressive microenvironment that resists standard radiotherapy. While Stereotactic Radiosurgery (SRS) can induce immunogenic cell death (ICD), the optimal sequencing of SRS combined with Conventional Fractionated Radiotherapy (CFRT) remains undefined. This study investigates the mechanistic superiority of induction SRS versus sequential boosting and reports outcomes from a translational pilot cohort.

Methods: Preclinical: C57BL/6 mice with orthotopic G261-luc gliomas received either Induction Radiotherapy (IR: CyberKnife 6Gy → CFRT 2Gy) or Sequential Radiotherapy (SR: CFRT 2Gy → CyberKnife 6Gy). Immune profiling was performed via immunofluorescence, damage-associated molecular patterns (DAMPs) gene analysis, and scRNA-seq. Clinical: A pilot cohort of 12 HGG patients was analyzed. The novel induction regimen comprised SRS (20–30 Gy in 4–5 fractions) followed by CFRT (20–30 Gy) with concurrent temozolomide. Primary endpoints overall survival (OS), secondary endpoints included safety profile, radiographic response (RANO criteria), clinical symptom improvement, and corticosteroid tapering rate

Results: Preclinical: The IR strategy yielded superior early tumor control compared to SR. Mechanistically, IR significantly upregulated Calreticulin expression ($p<0.05$) compared to the sequential approach, without significantly altering other DAMPs. This distinct ICD profile facilitated the recruitment of CD8+ T cells and activation of APC-like microglia within the tumor microenvironment. Clinical: In the translational cohort (median age 57), the induction FSRS regimen was well-tolerated with no Grade 4 toxicities and only one case of Grade 3 rash. The median Overall Survival was 18.11 months. The objective response rate was 91.7% (50.0% CR, 41.7% PR), with rapid tumor regression observed on MRI.

Conclusion: This study establishes proof-of-concept evidence that SRS prior to CFRT functions as a potent immune primer, superior to sequential boosting. By inducing calreticulin-mediated immunogenic cell death and recruiting cytotoxic lymphocytes, induction SRS translates into favorable survival and response rates. These findings have prompted the initiation of a multi-center validation trial

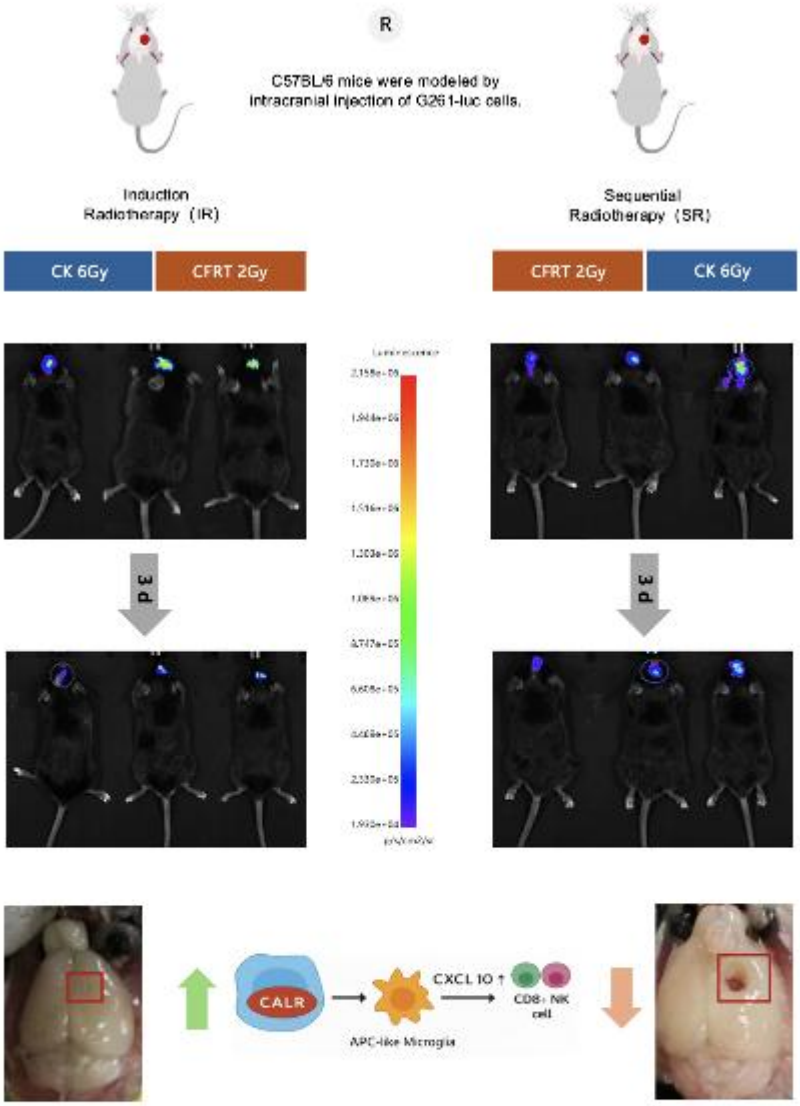

Figure 1: Induction Radiotherapy (IR) demonstrates superior early tumor control compared to Sequential Radiotherapy (SR).

C57BL/6 mice with intracranial G261-luc tumors (N=3) received IR (CK 6Gy → CFRT 2Gy) or SR (CFRT 2Gy → CK 6Gy). Bioluminescence Imaging (BLI) displays the early therapeutic outcome, indicating lower tumor burden after IR. The model proposed below suggests that the optimal IR schedule facilitates immunogenic cell death (ICD) and hypothetically promotes CALR exposure, leading to APC-like microglia activation. This cascade is hypothesized to recruit cytotoxic CD8+ T/NK cells, driving enhanced anti-tumor immunity and contributing to the superior control observed.

(Abbreviations: **IR** = Induction Radiotherapy; **SR** = Sequential Radiotherapy; **CK** = CyberKnife; **CFRT** = Conventional Fractionated Radiotherapy; **BLI** = Bioluminescence Imaging; **ICD** = Immunogenic Cell Death; **CALR** = Calreticulin; **APC** = Antigen-Presenting Cell; **CD8+ T cells** = Cluster of Differentiation 8 Positive T cells; **NK cells** = Natural Killer cells.)

(NCT04547621).

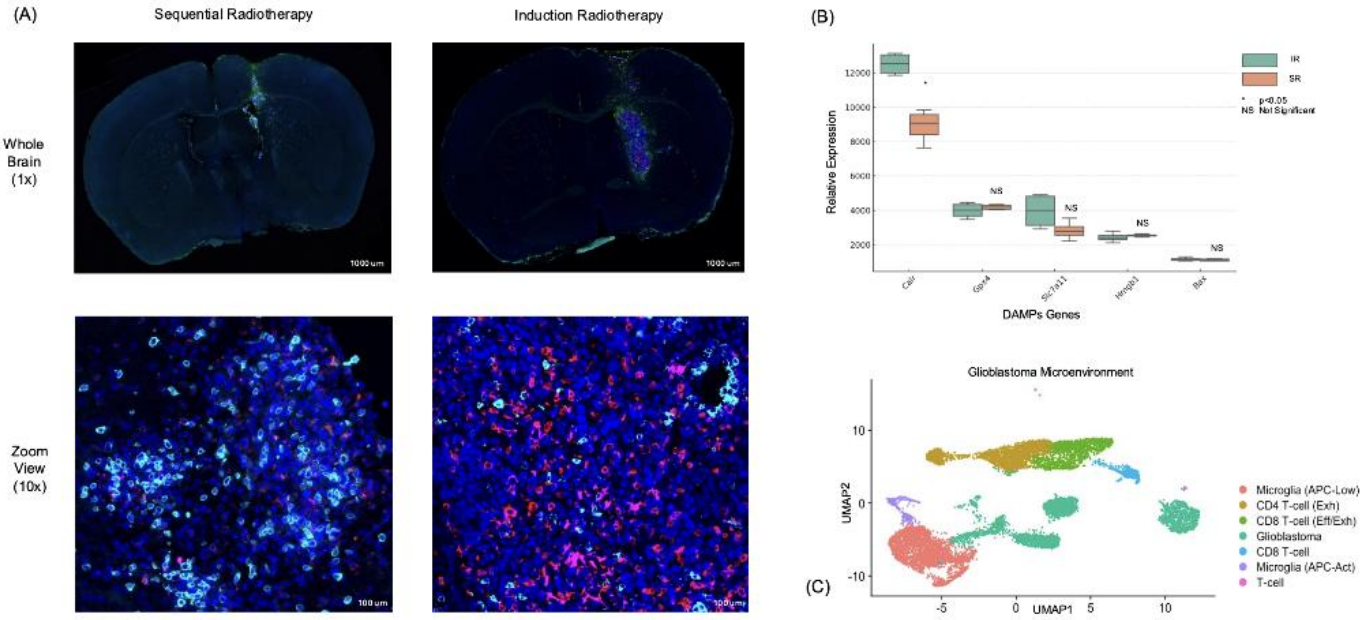

Figure 2. Induction radiotherapy triggers immunogenic cell death and enhances immune cell infiltration in the glioblastoma microenvironment.

(A) Representative immunofluorescence images of whole brain sections (top, scale bar = 1000 µm) and high-magnification tumor regions (bottom, scale bar = 100 µm). Tissues were stained for **CD4** (light blue), **CD8** (red), **APC-like Microglia** (purple), and nuclei (**DAPI**, dark blue). The IR group exhibits increased infiltration of T cells and APC-like microglia compared to the Sequential Radiotherapy group.
(B) Box plots showing the relative expression of DAMP-related genes. *Calr* (Calreticulin) is significantly upregulated in (IR) group compared to the SR group ($P < 0.05$), suggesting induced immunogenic cell death. Other markers (*Gpx4*, *Slc7a11*, *Hmgb1*, *Bax*) showed no statistically significant differences.
(C) UMAP visualization of the glioblastoma immune microenvironment derived from single-cell RNA sequencing. The plot reveals distinct cellular clusters, including glioblastoma cells, CD8+ T cell subsets (Effector/Exhausted), CD4+ T cells, and distinct microglia states (APC-Act/Low).

(**Abbreviations: IR**, induction radiotherapy; **SR**, sequential radiotherapy; **DAMPs**, damage-associated molecular patterns; **Calr**, Calreticulin; **UMAP**, Uniform Manifold Approximation and Projection; **APC**, antigen-presenting cell; **NS**, not significant.)

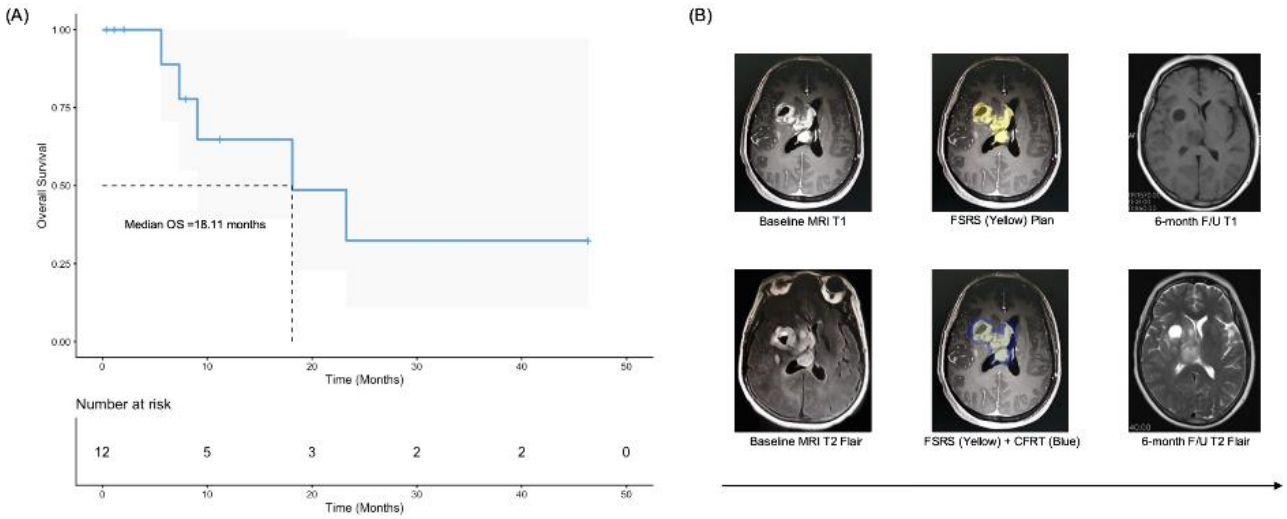

Figure 3. Clinical outcomes and representative radiographic response of High-Grade Glioma patients treated with SRS boost followed by conventional radiotherapy.

(A) Kaplan-Meier estimate of overall survival (OS) for the entire cohort (n=12). The median overall survival was 18.11 months. The dashed lines indicate the median survival time probability (0.5).
(B) Representative case of a 56-year-old female patient diagnosed with **right basal ganglia high-grade diffuse glioma** by biopsy (Molecular profile: **IDH-wildtype, TERT promoter-mutant, MGMT promoter-unmethylated**). The patient received a combined regimen of **Fractionated Stereotactic Radiosurgery (FSRS)** (30 Gy in 5 fractions, prescribed to the 68% isodose line) and **Conventional Fractionated Radiotherapy (CFRT)** (20 Gy in 10 fractions) with concurrent and adjuvant temozolomide chemotherapy.
Top Row: Axial T1-weighted contrast-enhanced images. Bottom Row: Axial T2 FLAIR images.Columns: Left images show baseline tumor burden; Middle images display the FSRS dosimetry plan overlay; Right images show follow-up, demonstrating significant tumor regression.
Note: The cumulative Biological Effective Dose (BED) was 72 Gy (α/β =10), biologically equivalent to a standard dose of 60 Gy in 30 fractions (EQD2).
(Abbreviations: **OS,** overall survival; **FSRS,** fractionated stereotactic radiosurgery; **MRI,** magnetic resonance imaging; **CFRT,** conventional fractionated radiotherapy; **FLAIR,** fluid-attenuated inversion recovery; **TMZ,** temozolomide; **BED,** biological effective dose .)

Table 1. Baseline Characteristics of All Patients (N=12)

Parameter	N	%
Gender		
Male	8	66.7
Female	4	33.3
Age, years		
Median	57	/
Range	21 – 76	/
Symptoms at RT		
Yes	11	/
No	1	/
KPS at RT		
Median	50	/
Range	40 - 70	/
Changes in symptoms in 1 months		
Stable	6	50.0
Improved	5	41.7
Worsened	1	8.3
Diagnosis		
Glioblastoma	3	25.0
H3 K27M-mutant diffuse glioma	3	25.0
High Grade Glioma	6	50.0
Total	12	100

Table 2. Treatment Characteristics for All Patients (N=12)

Parameter	N	%
Method of diagnosis		
Complete Surgery	1	8.3
Incomplete Surgery	2	16.7
Unresectable (biopsy)	3	25.0
MRI\MRS\FET PET	6	50.0
Adjuvant treatment after surgery and radiosurgery		
Radiotherapy	12	100
TMZ	12	100
PTV		
Median	23.7	/
Range	16.3 – 54.4	/
Radiosurgery Treatment		
Dose (Gy)	20-30	
Fractions	4-5	
Iso-dose Line (%)	65-70	
Radiotherapy Treatment		
Dose (Gy)	20-30	
Fractions	10-15	
Corticosteroids at SRS		
Yes	11	91.7
No	1	8.3
Changes in corticosteroids		
Stable	3	25.0
Tapered	8	66.7
Increased	1	8.3
Best response by RANO		
CR	6	50.0
PR	5	41.7
SD	1	8.3
Cause of death (Total)	N=5	
Tumor Progression	3	60.0
Pneumonia	1	20.0
Spinal metastases	1	20.0
Total	12	100

Table 3. Adverse Events Occurred in this trial

Adverse Events	Total No. of Patients	No. of Patients		
		Grade 1	Grade 2	Grade 3/4
Hematologic				
Leukopenia		3	0	0
Neutropenia		1	1	0
Hypertriglyceridemia		2	1	
Nonhematologic				
Rash		1	2	1
AST*/ALT† increased		1	1	0
Hypothyroidism		0	1	0
Radiation Necrosis		1	0	0

*Aspartate aminotransferase
†Alanine aminotransferase

OP-008

ORAL PRESENTATION - INTRACRANIAL YOUNG INVESTIGATOR SESSION
01-06-2026 15:45 - 16:45

EFFECT OF NON-CONSECUTIVE TREATMENT DURING HYPO-FRACTIONATED STEREOTACTIC RADIOSURGERY (HF-SRS) FOR BRAIN METASTASES

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Background: Hypo-fractionated stereotactic radiosurgery (HF-SRS) has become a mainstay of treatment for brain metastases. HF-SRS schedules involving 3-5 fractions may not align with conventional 5-day clinical workflows due to interruptions over weekends or holidays. Radiobiological principals suggest that the outcomes of nonconsecutive treatment may differ from those of HF-SRS performed on consecutive days.

Methods: Retrospective review from 2018–2024 identified all adult patients who underwent HF-SRS for lung and breast cancer brain metastases at a single center. Patients were excluded if the treatment schedule was extended beyond 14 days or there was not at least three months of follow-up with imaging. Demographics data, tumor and treatment characteristics, and imaging-based progression outcomes were systematically collected; local failure (LF) and radiation necrosis (RN) was additionally assessed via Cox regression.

Results: Of the 197 included lesions from 76 patients, 84 (42.6%) experienced interruptions (mean: 3.3 days) in HF-SRS treatment. The mean age of the cohort was 62.9 years (range 29-90) with 61 (80.3%) female patients. There were 49 (64.5%) lung and 27 (35.5%) breast cancer patients. The average number of tumors treated was 2.59 with a mean margin dose of 26.1 Gy. There were no significant demographic, pre-SRS, or SRS treatment differences between the interrupted and non-interrupted subgroups. There was no difference between the interrupted and non-interrupted subgroups for the cumulative incidence of LF (p=0.620) nor cumulative incidence of RN (0.714). Sub-group analysis did not demonstrate an effect of treatment interruption on LF or RN in surgically resected lesions (p=0.721, p=0.500) or SRS-treated only lesions (p=0.436, p=0.790). Overall follow-up was 25.1 months with no difference between subgroups.

Conclusions: There was no significant difference in LF or RN in patients with brain metastases from lung and breast carcinoma treated with consecutive versus nonconsecutive HF-SRS.

OP-009

ORAL PRESENTATION - INTRACRANIAL YOUNG INVESTIGATOR SESSION
01-06-2026 15:45 - 16:45

NADPH OXIDASE 3 INHIBITION PRESERVES HEARING IN MICE AFTER STEREOTACTIC RADIOSURGERY

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Background Stereotactic radiosurgery (SRS) is a standard treatment for vestibular schwannoma but carries a significant risk of progressive and irreversible hearing loss. NADPH oxidase 3 (NOX3), predominantly expressed in the cochlea, is a major source of oxidative stress and a candidate mediator of radiation-induced cochlear injury. We evaluated whether genetic deletion or transient inhibition of *Nox3* can preserve auditory function following SRS.

Methods C57BL/6J mice received unilateral 32 Gy near cochlear-targeted irradiation using a Gamma Knife ICON system. Two strategies were tested: (1) comparison of wild-type, heterozygous, and *Nox3*-deficient littermates (n=8 per group) and (2) local delivery of siRNA targeting *Nox3* (siNox3) versus scrambled control (siScr) 48 hours before irradiation (n=14 per group). Auditory brainstem responses (ABRs) were recorded before and 1 and 4 weeks post-SRS. Cochlear histology was performed at week 4.

Results Following SRS, wild-type mice developed progressive high-frequency hearing loss by week 4, whereas *Nox3*-deficient littermates showed complete preservation of auditory thresholds, with significant differences across 2.8–32 kHz ($p<0.01$–$p<0.0001$). Heterozygous mice exhibited an intermediate phenotype. Histology showed preserved inner hair cells in all groups, but wild-type mice displayed marked outer hair cell (OHC) and ribbon synapse loss with mild spiral ganglion neuron (SGN) reduction in the basal turn, partially attenuated in heterozygous and absent in *Nox3*-deficient mice. Similarly, siNox3-treated mice were largely protected from SRS-induced hearing loss, with significant auditory threshold differences compared with siScr controls across 5.6–32 kHz ($p<0.05$–$p<0.0001$). siScr-treated mice showed histological injury resembling the wild-type group, whereas siNox3-treated mice preserved synapses and SGNs with only mild high-frequency OHC loss.

Conclusions Both genetic deletion and siRNA-mediated knockdown of *Nox3* prevent functional and structural cochlear injury following SRS, identifying NOX3 as a key driver of ototoxicity and a promising therapeutic target.

OP-010

ORAL PRESENTATION - INTRACRANIAL RADIOBIOLOGY
01-06-2026 15:45 - 16:45

VARIATION OF THE BIOLOGICAL EFFECTIVE DOSE (BED) DELIVERED DEPENDING ON TREATMENT DEVICE

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Many Gamma Knife (GK) studies suggest that biological effective dose (BED) better predicts clinical outcomes than physical dose. BED increases with faster treatment times as sub-lethal damage repair, ignored by the linear-quadratic (LQ) model, is reduced. However, little data exists that compares BED in stereotactic radiosurgery (SRS) between GK, where many SRS doses originate, and faster linear accelerators. We illustrate the importance to consider treatment duration when prescribing SRS and demonstrate BED reduction strategies on linear accelerators 1031 VS patients were treated between 2001 and 2025 with GK Model B (219), Perfexion (344), Cyberknife VSI (193), or Truebeam (VMAT 169, DCA 106) with one- (813) or multiple- (218) fraction regimens of 11/1, 12/1, 12.5/1, 13/1, 14/1Gy, 18/3, 25/5, or 27.5/5Gy. Truebeam used GTV-to-PTV margins of 0(206), 0.5(45) or 1mm(35). GK and CK didn't use margins. BEDs used Jones' A9 formalism, with α/β=2.47Gy and fast and slow repair half-times of 11.4 and 129.6 minutes, respectively. Mean treatment times were 55.5, 44.3, 30.1 and 8.1 minutes for Model B, Perfexion, Cyberknife and Truebeam, respectively. GK 12-Gy/1 mean BED (mBED) ($55Gy_{2.47}$) was the primary comparator for Cyberknife and Truebeam mBEDs. No margin, single fraction mBEDs increased by 7.3% and 25.7%, at 12Gy for Cyberknife and Truebeam, respectively, while at 18Gy/3, Cyberknife mBEDs decreased 1% and increased 12.4% for Truebeam. At 25Gy/5 and 27.5Gy/5, Truebeam mBEDs increased 42.9% and 67.6%, respectively. GTV-to-PTV margins increased mBEDs by 42% for 12Gy/1 with 0.5mm margin and by 57% and 83.1% for 25Gy/5 and 27.5Gy/5 respectively with 1mm margin.11Gy/1 with Truebeam resulted in mBED increase of only 8.5% compared to GK. Faster Truebeam delivery times yielded mBEDs significantly greater than GK or Cyberknife, for the same physical dose. Additional margins exaggerated the BED differential, increasing toxicity risk. These results provide critical guidance to clinicians using SRS linac-based systems.

OP-011

ORAL PRESENTATION - INTRACRANIAL RADIOBIOLOGY
01-06-2026 15:45 - 16:45

WHAT DOES BED ADD?: A PRELIMINARY INVESTIGATION USING INFORMATION CRITERIA METRICS.

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Introduction Biological effective dose (BED)—including modeling of time-dependent sublethal repair—has recently been explored as a predictor of treatment effectiveness in stereotactic radiosurgery (SRS). However, while BED has been shown to be predictive of SRS outcomes (e.g., probability of local failure/time to local failure), it remains unclear how much new information BED adds beyond absorbed dose. This project presents a preliminary investigation of the utility of BED from an information criteria perspective.

Methods A dataset from a previously published series on parasellar meningioma was re-analyzed to compare the tradeoff between model fit and model complexity using Akaike Information Criterion (AIC). Logistic regression (outcome = probability of local tumor progression) and Cox regression (outcome = time to local progression) models were fit using predictors found to be statistically significant in the original multivariate analysis, including number of prior surgical resections, tumor volume (units cm^3), and prescription dose (units Gy). Three variants of each model were created: a model with prescription absorbed dose as a predictor (Dose model), a model with BED as a predictor (BED model), and a model with both prescription dose and BED predictors (combined model). AIC was calculated for each pair of models. (Partial AIC (pAIC) was calculated for Cox regression, as it is non-parametric). $\Delta AIC = AIC_i - min(AIC)$ was calculated for each pair of logistic regression and each pair of Cox regression models.

Results For logistic regression, AIC = 62.9107 / 64.7822 / 62.8914 for Dose / BED / Combined models, respectively. For Cox regression, pAIC = 94.7359 / 95.9510 / 95.8000 for Dose / BED / Combined models.

Conclusion The small (for all model pairs, $\Delta AIC < 2.0$) inter-model AIC differences provide only minimal support for adding BED to the regression models. Further work will be presented that systematically characterizes the utility of BED with time-dependent repair models.

OP-013

ORAL PRESENTATION - INTRACRANIAL RADIOBIOLOGY
01-06-2026 15:45 - 16:45

RETROSPECTIVE STUDY FOR LENS DOSE IN GAMMA KNIFE TREATMENT

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Introduction: In Radiotherapy, lens dose monitoring for a single fraction with a dose limit of 2 Gy has been widely adopted, however, emerging evidence suggests that lens opacification may occur at substantially lower doses, or perhaps with no threshold. In 2011, the International Commission on Radiological Protection recommended a lower dose threshold of 0.5 Gy, for radiation-induced cataracts, based on epidemiological evidence. The aim of this study was to review current institutional practice, identify factors contributing to lens dose, and evaluate whether re-planning cases with lens doses exceeding 0.5 Gy could reduce exposure without compromising plan quality or target coverage.

Method: Retrospectively we evaluated lens dose for 305 randomly selected patients who underwent Gamma Knife Radiosurgery and investigated the effect of lesion location, volume and dose to the lens. For treatment plans identified with lens doses exceeding 0.5Gy, we replanned using lightning inverse optimisation, defining the lens as a risk volume, to investigate whether lens doses could have been reduced without compromising the plan quality and dose statistics (i.e. coverage, conformity, OAR tolerances), in line with radiological protection principles and the ALARA (As Low As Reasonably Achievable) standard.

Results: Of a total of 305 patients, 14% of patients received more than 0.5 Gy to a lens [0.6 – 1.4 Gy]. The patient group that contained the highest proportion that exceeded the 0.5Gy were paediatric AVM and multiple metastases patients. For the replanned treatments, plan quality and 0.5Gy lens dose was achieved.

Conclusion: Target location, volume, prescription dose significantly influence the lens doses exceeding 0.5 Gy tolerance dose. Treatment planning must carefully consider lens sparing without compromising target coverage, for patients with benign or vascular lesions, and especially for paediatric populations with long life expectancy, adherence to a 0.5 Gy lens constraint might help minimize the risk of early radiation-induced cataracts.

OP-014

ORAL PRESENTATION - INTRACRANIAL ARTIFICIAL INTELLIGENCE IN RADIOSURGERY
01-06-2026 15:45 - 16:45

PATIENT AND MRI SPECIFIC DISTORTION CORRECTION IN ENHANCING DOSIMETRIC ACCURACY WITH STEREOTACTIC RADIOSURGERY

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Purpose: This study examines the efficacy of artificial intelligence software in adjusting for patient specific MRI distortions within frameless stereotactic radiosurgery (SRS) treatments dosimetric accuracy.

Methods: Patients with frameless SRS treatment planning with a single isocenter treatment planning without patient specific distortion correction algorithmic adjustment to planning MRI were retrospectively assessed. This included 18 total evaluable patients with 24 evaluable lesions. Distortion within patients' MRIs were evaluated using Cranial Distortion Correction software altering planning MRI to conform to planning CT to reduce inherent distortion. Distortion was evaluated by comparing the original planning target volumes (GTVorig) to targets contoured on corrected MRIs (GTVcorr) by DICE. To provide internal control, targets were also re-contoured on uncorrected (GTVrecon) MRI. Additional assessments were made by creating matching PTV evaluation of each target orig, corr, and recon.

Results: Comparing GTVcorr and GTVorig volumes, GTVcorr were reduced with distortion correction by 0.092cc +/- 0.157cc ($p<0.01$). Prescription coverage of GTVorig was 99.7-100% compared to GTVcorr 90.8-100% of the prescribed dose with coverage remaining >99% for 91.7% of targets. PTV analysis suggested further decline in dosimetric quality with mean inverse conformity index PTVorig 1.19 compared to PTVcorr 1.38. A corresponding mean D95% PTVorig was 99.5% with reduction to <97% with PTVcorr with 6 PTVcorr targets exhibiting D95% of <95%. Minimum dose was reduced in PTVorig vs PTVrecon and PTVorig vs PTV corr, but D95% was maintained in PTVorig vs PTV recon ($p=0.52$) compared to PTVcorr vs PTVrecon and PTVcorr vs PTC orig ($p=0.03$ and $p<0.01$).

Conclusions: In the absence of patient specific distortion correction, broad dosimetric accuracy was maintain in the majority of targets. However, reduction was noted where distortion plays an outsized role in dosimetric inaccuracy that is larger than can be explained by contouring variablity. In these instances, simple uniform expanded PTV may not account for the error in distortion alone to maintain plan quality.

OP-015

ORAL PRESENTATION - INTRACRANIAL ARTIFICIAL INTELLIGENCE IN RADIOSURGERY
01-06-2026 15:45 - 16:45

AN AUTOMATED PIPELINE FOR BRAIN TUMOUR SEGMENTATION ON MRI IMAGES FOR GAMMA KNIFE RADIOSURGERY

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Background: Accurate delineation of intracranial tumours is crucial for stereotactic radiosurgery. We developed and implemented an in-house, end-to-end automated pipeline for segmenting brain metastases, pituitary adenoma, vestibular schwannoma, and meningioma for clinical review.

Methods

The models were trained on T1-weighted MPRAGE MRI images using the nnU-Net (3D full-resolution) model architecture. For model development, 100 cases per tumour type (n=400) were used with an 80/20 training–validation split. To evaluate the clinical workflow, 25 additional cases per tumour type (n=100) were processed prospectively. The performance was quantified using Dice Score (DSC), 95th Percentile Hausdorff distance (HD95) and Average Symmetric Surface Distance (ASSD). The pipeline monitors the incoming DICOM images via a watchdog, infers the tumour type from metadata, and applies the appropriate model for auto-segmentation. The DICOM images, along with DICOM RT structures, are automatically exported to the treatment planning system upon prediction.

Results

Vestibular schwannoma demonstrated the highest mean DSC of 0.90 ± 0.03, accompanied by an HD95 of 0.93 ± 0.34 mm. Brain metastases achieved a DSC of 0.83 ± 0.08 and an HD95 of 1.33 ± 0.55 mm. Pituitary adenoma showed a DSC of 0.81 ± 0.09 with an HD95 of 2.39 ± 1.14 mm, while meningioma scored a DSC of 0.80 ± 0.11 and an HD95 of 4.46 ± 3.64 mm. Across all tumour types, segmentation variability was modest (Std dev < 0.11). indicating consistent model performance. Tumour volume segmentation was completed in approximately 3 minutes per case, providing contours ready for review by the radiation oncologist.

Conclusion

Our in-house automated segmentation pipeline enables consistent and rapid delineation of multiple intracranial tumours, achieving clinically acceptable performance metrics and efficiency suitable for stereotactic radiosurgery planning.

OP-016

ORAL PRESENTATION - INTRACRANIAL ARTIFICIAL INTELLIGENCE IN RADIOSURGERY
01-06-2026 15:45 - 16:45

A WEB-BASED SOFTWARE PLATFORM FOR VESTIBULAR SCHWANNOMA AUTO-SEGMENTATION AND TREATMENT FOLLOW-UP

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Background: Vestibular schwannomas (VS) require long-term tracking for treatment decisions and outcome assessment. This study aims to develop a web-based software platform that combines AI-driven segmentation with a user-friendly interface to automatically segment VS and track longitudinal volumes for disease assessment, planning, and monitoring.

Methods: The home-grown software platforms was built using nnU-Net as the backbone for auto-segmentation, with three models trained and validated on combinations of various image modalities. Auto-segmentation performance was evaluated with multiple metrics including absolute and relative volume differences (AVD/RVD), Dice score, mean surface-to-surface distance (MSSD), and 95th percentile Hausdorff distance (HD95). The platform features a central database with DICOM-RT import/export capabilities, and its interface is built using Rust and WebAssembly.

Results: Three models demonstrated comparable performance without significant differences. Mean Dice scores ranged from 0.89-0.90 across models. AVD ranged from 0.11-0.13cc, while RVD ranged from 10.70-13.44%. MSSD and HD95 values were consistently low (0.14-0.19mm) and (0.74-0.88mm) respectively. Average inference time was approximately 60 seconds per case. The platform successfully enabled longitudinal tumor volume tracking and provided flexible visualization options including single and multiple image views and graphical representation of volume changes over time.

Conclusions: We have developed a comprehensive platform that combines automated segmentation with longitudinal tracking to support VS management. The AI models achieved Dice scores comparable to interobserver variability in manual contouring, indicating clinical adequacy. The tracking capability provides consistency in treatment planning and monitoring and opens the possibility to advance AI-driven segmentation and streamline workflows for other intracranial pathologies.

OP-017

ORAL PRESENTATION - INTRACRANIAL ARTIFICIAL INTELLIGENCE IN RADIOSURGERY
01-06-2026 15:45 - 16:45

EVALUATING CLINICAL ACCEPTANCE OF ARTIFICIAL INTELLIGENCE DRIVEN AUTO-SEGMENTATION FOR BRAIN METASTASES

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Background For optimal tumour control and normal tissue-sparing, accurate and precise contouring and radiotherapy delivery is critical when undertaking stereotactic radiosurgery (SRS). While manual contouring by Radiation Oncologists (ROs) remains the current standard practice, it can be time-consuming and subject to inter- and intra-observer variability. Artificial intelligence (AI)-segmentation software may improve workflow efficiency and contouring consistency. Siemens' AI Rad Companion (AIRC, Siemens Medical Solutions USA, Inc) is a commercially available option for AI-segmentation for BM. To our knowledge there are no independent, peer-reviewed reports on its clinical performance.

Objective To evaluate the performance of AIRC for auto-segmentation of BM.

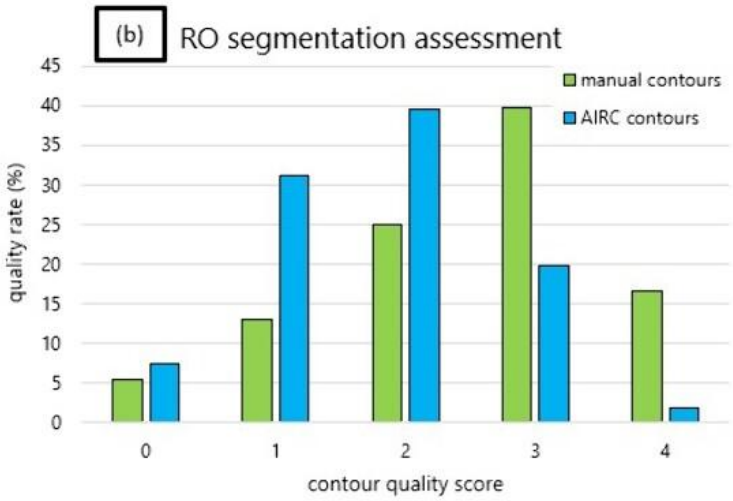
Methods Ten T1 contrast-enhanced SRS-planning MRI datasets (10-minute post-Gadolinium, 1mm slices) were retrospectively selected from patients treated at our institute between January 2024 and August 2025. Each case included ≥5 BM, contoured by a single experienced RO, to minimise inter-observer variability. AI-segmentation was performed using AIRC. Quantitative lesion detection sensitivity and false detection rates of AIRC were assessed, with manual RO contours taken as ground-truth. Additionally, blinded, qualitative assessment of the clinical acceptance of AI-generated contours was performed by a second credentialed RO using a Likert scale (figure 1a).

Preliminary Results Manual RO contours included 108 lesions, while AIRC identified 106 lesions. The mean sensitivity was 84%, while 11% of AI-contours were false positives. Nearly 80% of AIRC contours required major edits or were not considered appropriate for use (figure 1b). For targets that were identified by both manual and AI-segmentation, manual contours were usually preferred (58%) with AIRC preferred in 15% of cases (figure 1c).

Conclusion AIRC contouring may aide in BM identification, but findings suggest significant manual edits are required to render the AI contours clinically acceptable for SRS planning. Ongoing evaluations include the dosimetric impact of SRS-planning on unedited AI target

contours.

Score	Percentage of Slices Requiring Modification	Quality Assessment (a)
0	NA	Not a metastasis
1	> 30%	Not worth using
2	10-30%	Caution - major edits required
3	< 10%	Clinically useful with minor edits
4	0%	Clinically acceptable without edits



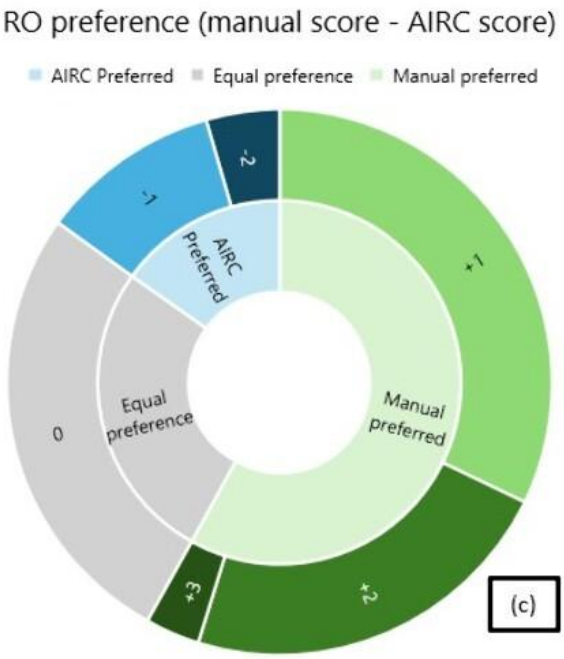


Figure 1: (a) A Likert scale was used to determine (b) the distribution of segmentation quality, and (c) the RO preference where a BM was identified by both manual and AI-contouring. Inter-observer review accounts for distribution of scores for manual contours.

OP-018

ORAL PRESENTATION - INTRACRANIAL ARTIFICIAL INTELLIGENCE IN RADIOSURGERY
01-06-2026 15:45 - 16:45

EVALUATION OF FLUCICLOVINE PET, RCBV, AND TEMPORAL FACTORS IN DIFFERENTIATING RECURRENCE FROM RADIONECROSIS AFTER SRS FOR BRAIN METASTASES: PRELIMINARY RESULTS

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BACKGROUND
Amino acid PET and perfusion MRI are increasingly being utilized to distinguish tumor recurrence from radiation necrosis (RN) after stereotactic radiosurgery (SRS). We aimed to evaluate the diagnostic value of PET, relative cerebral blood volume (rCBV), and clinical factors in distinguishing tumor recurrence from radiation necrosis.

METHODS
We queried our institutional database for patients treated with SRS with suspected recurrence evaluated by perfusion MRI and 18F-fluciclovine PET before repeat preoperative SRS and resection. Independent variables that were assessed included SUVmax, rCBV (1 = high, 0 = low), interval since initial SRS, and initial treatment approach (pre-operative, post-operative, or definitive SRS) with the outcome of interest being final pathology on resection (tumor vs RN). Mann-Whitney U, Fisher's exact test, Spearman correlation, and ROC analysis were performed.

RESULTS
Seventeen lesions were analyzed, with final pathology demonstrating active tumor and RN in 7 and 10 cases, respectively. Median SUVmax in tumors and RN were 5.3 (range: 2.1-10.1) and 6.6 (range: 3.2-15.2), respectively. SUVmax did not robustly differentiate tumor from RN (AUC = 0.34). Low perfusion was noted only in RN cases (4/4; p=0.10). The interval since initial SRS was the strongest predictor of pathology (tumor: median 378 days vs. RN: 1152 days; U = 5, p = 0.003; AUC = 0.89) with all lesions examined >900 days after initial SRS being RN (7/7). All 7 cases of tumor recurrence were initially treated with SRS alone (vs. 4 of 10 cases of RN treated with initial SRS alone) (p=0.043).

CONCLUSION
Initial treatment approach and interval since initial SRS demonstrated superior diagnostic value vs. rCBV and SUVmax. Lesions evaluated well after SRS showed a low likelihood of viable tumor. PET imaging may have improved diagnostic accuracy for intact lesions felt to have early recurrence. These results require confirmation in larger cohorts.

OP-019

ORAL PRESENTATION - INTRACRANIAL BRAIN METASTASES
01-06-2026 17:15 - 18:15

TRIAL IN PROGRESS: EXCLAIM: EXPLORING COMBINED LOCAL AND SYSTEMIC APPROACHES IN BRAIN METASTASIS: A RANDOMIZED PHASE II STUDY EVALUATING RESPONSE TO SYSTEMIC THERAPY AND INTEGRATION OF RADIOSURGERY FOR BRAIN METASTASES.

Thomas Beckham[1], Todd Swanson[1], Brian De[1], Subha Perni[1], Martin Tom[1], Jing Li[1], Mary Frances Mcaleer[1], Xiuning Le[2], Rashmi Murthy[3], Sherise Ferguson[4], Hussein Tawbi[5], Diana Kaya[6], Isabella Glitza[5], Ecaterina Dumbrava[7]
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Background: CNS-active systemic therapies are increasingly available as management options for brain metastases, however optimal integration with standard of care local therapies such as stereotactic radiosurgery (SRS) is poorly understood.

Trial In Progress: We are conducting a multi-cohort Phase II trial to explore the optimal integration of SRS in patients managed with upfront CNS-active systemic therapies. This is a multi-histology study enrolling patients whom, in the opinion of the brain metastasis multidisciplinary team (BM-MDT; consisting of a medical oncologist, a radiation oncologist who regularly performs SRS, and a neurosurgeon) have brain metastases for which local therapy can be safely omitted and observed on CNS-active systemic therapy. Two cohorts are enrolling and will be evaluated separately: patients with study systemic therapy containing immunotherapy and those without immunotherapy. Patients are observed on systemic therapy with an early response assessment MRI at 6 weeks. Those with complete response (CR) or near CR continue observation. Patients with stable disease (SD) or partial response (PR) are eligible for randomization between continued observation and consolidative SRS (cSRS). At the time of intracranial progression, patients who are not progressing in all brain metastases (intracranial “oligoprogression”) are eligible for a second randomization between SRS only to progressing lesions (progression directed SRS, pdSRS) or SRS to all lesions not in CR. The primary endpoint of both randomizations is CNS-PFS. Secondary and exploratory endpoints include reporting response rates and durability of response to individual systemic therapy regimens, downstream adverse events such as radiation necrosis, leptomeningeal disease, and events associated with CNS progression, and comparison between volumetric response assessment and mRECIST 1.1.

Summary: Brain metastasis management is evolving, and the advent of CNS-active systemic therapies is a welcome addition to our therapeutic armamentarium. Dedicated evaluation of integration of local and systemic therapies is essential to ensuring optimal patient outcomes. NCT06649058.

OP-020

ORAL PRESENTATION - INTRACRANIAL BRAIN METASTASES
01-06-2026 17:15 - 18:15

BASELINE AND TIME-DEPENDENT PREDICTORS OF COGNITIVE DECLINE FOR BRAIN METASTASIS PATIENTS TREATED WITH RADIOTHERAPY – A SECONDARY ANALYSIS OF THE ATHENA TRIAL

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Purpose: The extent to which radiotherapy contributes to cognitive decline, versus initial cancer burden and subsequent events such as systemic therapy administration, intracranial progression, and systemic progression is unclear. This secondary analysis of a Phase 2 Randomized Controlled Trial evaluates the impact of baseline and time-dependent clinical and treatment characteristics on cognitive decline.

Methods: This is a planned secondary analysis of a clinical trial in which patients with brain metastases were randomized 1:1 to either brain radiation alone or brain radiation with neuropsychology evaluation and intervention. All patients with >15 brain metastases received a pre-specified radiation technique termed memory-avoidance whole brain radiotherapy. Patients with ≤15 brain metastases received stereotactic radiosurgery. Previous endpoint analyses showed no difference in cognitive decline between the control and intervention arm. Baseline pretreatment characteristics were collected. Receipt of systemic therapy after trial enrollment, intracranial disease status, systemic disease status, and survival were evaluated for at least 12 months after trial enrollment. Cognition was measured by Hopkins Verbal Learning Test-Revised, Controlled Oral Word Association Test, and Trail Making Test A/B. Cognitive decline was defined as a decline on at least one assessment using the reliable change index.

Results: Between August 2022 and June 2024, 110 patients were enrolled on the ATHENA Trial and eligible for analysis. On univariable analysis, increased brain tumor volume (0.044), intracranial progression (p=0.034), and systemic progression (p = 0.005) were predictive of cognitive decline. On

multivariable analysis, only systemic progression retained an association with cognitive decline (p=0.026).

Conclusion: For brain metastases patients treated with radiotherapy, intracranial and systemic progression may be more predictive of cognitive decline than traditional implicating factors such as type of radiation, age, number of brain metastases, or systemic therapy administration. Cognitive intervention strategies for any patient with high intracranial tumor burden or progressing systemic disease may be warranted.

OP-021

ORAL PRESENTATION - INTRACRANIAL BRAIN METASTASES
01-06-2026 17:15 - 18:15

TUMOR DYNAMICS, DOSIMETRIC IMPACT, AND PREDICTORS OF GEOMETRIC CHANGES DURING MULTI-DAY ADAPTIVE STEREOTACTIC RADIOSURGERY FOR MULTIPLE BRAIN METASTASES

Ibrahim Durowoju[1], James Stewart[1], Lori Holden[1], Mark Ruschin[1], Hany Soliman[1], Sten Myrehaug[1], Jay Detsky[1], Hanbo Chen[1], Deepak Dinakaran[1], Eshetu Atenafu[2], Arjun Sahgal[1], Chia-Lin Tseng[1]
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Purpose: The goal of this study was to quantify lesion-level dynamics, its consequent dosimetric impact, and to evaluate the role of interim MRI (iMRI) during multi-day frameless spatially partitioned adaptive radiosurgery (SRS) for brain metastases (BM) on the Gamma Knife Icon (GKI-Spr).

Materials & Methods: Consecutive patients with multiple BM treated with GKI-Spr between 2020 and 2025, who underwent at least one iMRI, were retrospectively reviewed. For each lesion, geometric metrics including volumetric changes and migration distance (linear displacement relative to reference planning MRI, rMRI) were assessed. rMRI dose distributions were mapped onto iMRI contours to estimate potential dosimetric impact. Linear mixed model analysis was used to assess predictors of volumetric change.

Results: A total of 696 BM were identified in 51 patients. Of these, 328 metastases (47.1%) were re-contoured and re-planned in 31 patients. The median number of BM was 24 (range, 3-63) at rMRI with a median of 5 (range, 0-28) re-contoured BM at iMRI per patient. The median time between consecutive MRIs was 12 days (range, 2-23 days). At iMRI, the median volumetric change of re-contoured metastases was 0.02 cm^3 (range, -14.79-5.15 cm^3), the median migration distance was 1.5 mm (IQR 1.0-2.1 mm), and 33.5% migrated > 1 mm. Without adaptation, mean volume receiving prescription dose (V100) decreased from 99.96% to 91.95% ($p<0.0001$); BM with V100 <98% and <95% increased from 0.3% to 39.4% and from 0% to 30.3%, respectively. On multivariable analysis, systemic therapy administered within 1 month before or concurrently with SRS ($p=0.0232$) and prior whole brain radiation within 3 months of SRS ($p=0.0147$) predicted for volumetric changes.

Conclusions: Clinically meaningful geometric changes occurred during multi-day SRS for multiple BM, which can result in significant dosimetric impact without adaptation guided by iMRI, supporting the role of iMRI to guide mid-treatment adaptive re-planning in selected patients.

OP-022

ORAL PRESENTATION - INTRACRANIAL BRAIN METASTASES
01-06-2026 17:15 - 18:15

PROPENSITY SCORE–MATCHED SUBANALYSIS OF STEREOTACTIC RADIOSURGERY FOR METASTATIC BRAIN TUMORS USING THE LEKSELL GAMMA KNIFE ICON MASK SYSTEM: IMPACT OF METASTASIS NUMBER AND TUMOR VOLUME BEYOND THE JLGK0901 CRITERIA

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Objective: Stereotactic radiosurgery (SRS) for metastatic brain tumors (METs) has previously been considered indicated only for cases with a limited number of small lesions. Expansion of SRS indications is mainly attributed to the JLGK0901 study. Furthermore, since the introduction of the Leksell Gamma Knife Icon, both single and fractionated irradiation have become feasible using a mask fixation system. This study aimed to reexamine, through a subanalysis, the impact of metastasis number and total tumor volume beyond the limitations established in the JLGK0901 study.

Methods: This retrospective study included 1,043 patients who underwent initial treatment with the Gamma Knife Icon at Rakusai Shimizu Hospital over a 6.5-year period and had at least one post-treatment follow-up. Patients meeting the JLGK0901 criteria were classified as Group A, while those exceeding the criteria were classified as Group B (extended indication). Group B was further subdivided into B-1 (exceeding the criteria for the number of metastases only; $n = 100$) and B-2 (exceeding the criteria for total tumor volume only; $n = 194$). Propensity score matching was performed for each subgroup comparison. Neurological death was the primary endpoint.

Results: Compared with Group A, median survival time was significantly shorter in B-1 and B-2 ($p < 0.01$ and $p = 0.015$). However, no significant differences were observed in neurological death ($p = 0.514$ and $p = 0.595$), poor local control ($p = 0.482$ and $p = 0.466$), neurological deterioration ($p = 0.820$ and $p = 0.624$), or severe radiation-induced adverse events ($p = 0.399$ and $p = 0.857$). The incidence of new intracranial lesions was significantly higher in B-1 ($p < 0.01$), but not in B-2 ($p = 0.096$).

Conclusions: These results support expanding the indication for the Leksell Gamma Knife Icon for METs beyond the JLGK0901 criteria, as metastasis number and tumor volume did not adversely affect neurological outcomes.

OP-023

ORAL PRESENTATION - INTRACRANIAL BRAIN METASTASES
01-06-2026 17:15 - 18:15

PRELIMINARY CLINICAL STUDY USING MAGNETIC RESONANCE FINGERPRINTING AND INTRAVOXEL INCOHERENT MOTION IMAGING TO DIFFERENTIATE RADIATION NECROSIS FROM TUMOR RECURRENCE FOLLOWING STEREOTACTIC RADIOSURGERY

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Introduction: Stereotactic radiosurgery (SRS) effectively controls intracranial tumors, but post-treatment MRI interpretation remains challenging. Radiation necrosis and tumor recurrence often appear similar, complicating clinical decision making and leading to delayed interventions or unnecessary biopsies. Magnetic Resonance Fingerprinting (MRF) is a novel quantitative imaging technique that may improve tissue characterization. This study investigates the combined use of MRF and Intravoxel Incoherent Motion (IVIM) imaging to differentiate necrotic lesions from tumor recurrence after SRS.

Methods: Six patients with seven confirmed regions of radiation necrosis and three regions of tumor recurrence underwent MRF to generate T1 and T2 maps, along with IVIM imaging to assess diffusion (ADC) and perfusion (f) parameters. Quantitative values were compared between radiation necrosis and tumor recurrence, as well as with white matter in healthy volunteers, and with previously published tumor data. Histopathologic confirmation was obtained through surgical resection.

Results: Necrotic lesions demonstrated markedly elevated T1 (2528±327 ms) and T2 (256±113 ms) values compared with recurrent tumors (T1, 1924±152 ms, $P<0.05$; T2, 98±13 ms, $P=0.052$) and normal brain tissue (T1, 863±43 ms, $P<0.001$; T2, 37±1.6 ms; $P<0.001$). Compared with literature values for glioblastomas, low-grade tumors, and metastases (T1<2000 ms, T2<170 ms), necrotic lesions were distinctly higher, suggesting potential differentiation from tumor. IVIM analysis revealed significantly higher ADC values in necrotic lesions ($2.5\pm0.2\times10^{-3}$ mm^2/s) than in recurrent tumor ($1.2\pm0.3\times10^{-3}$ mm^2/s, $P<0.001$) and normal white matter ($0.62\pm0.04\times10^{-3}$ mm^2/s, $P<0.001$).Perfusion fraction was substantially lower in necrosis (f, 0.6±0.5%) compared with recurrence (12.7±6.6%, $P<0.01$) and normal white matter (9.1±2.8%, $P<0.001$).

Conclusion: These preliminary findings suggest that MRF combined with IVIM imaging provides complementary quantitative biomarkers that may enable noninvasive differentiation of radiation necrosis from tumor recurrence after SRS.

OP-024

ORAL PRESENTATION - INTRACRANIAL VESTIBULAR SCHWANNOMAS
01-06-2026 17:15 - 18:15

VOLUMETRIC OUTCOMES OF HYPOFRACTIONATED GAMMA KNIFE STEREOTACTIC RADIOSURGERY FOR KOOS GRADE III AND IV VESTIBULAR SCHWANNOMAS: A COMPARATIVE ANALYSIS

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Background: Stereotactic Radiosurgery (SRS) is a well-established treatment for vestibular schwannomas (VS). Hypofractionated SRS is an emerging alternative to single-fraction SRS, potentially offering superior tumor control with reduced toxicity. However, comparative data in Koos grade III and IV VS remains limited. This study evaluates the volumetric and clinical outcomes of hypofractionated Gamma Knife SRS (GKRS) and compares them with single-fraction GKRS.

Methods: A retrospective analysis of all patients with Koos grade III and IV VS treated with hypofractionated GKRS between May 2014 and May 2024 was performed, with at least six months of follow-up. Tumor volumes were measured at baseline and during follow-ups at 6, 18, and 24 months. Statistical significance of uni and multivariate analysis was considered at $p < 0.05$.

Results: Of 77 patients treated, 64 met inclusion criteria (32 hypofractionated GKRS, 32 single-fraction GKRS). Median age was 60 years ([IQR], 49.0–66.2 years). Most single-fraction patients received 12 Gy (65.6%), while hypofractionated patients predominantly received 18 Gy in three fractions (50%) or 25 Gy in five fractions (40.6%). The median follow-up duration for the entire cohort was 17.6 months (IQR, 6.92–51.5 months). At 6 months, a transient volume increase (+3.45%) was observed, followed by a reduction at 18 months (-7.14%) and 24 months (-28.13%). Final follow-up showed a mean volume reduction of -57.97%. Tumor volume reductions at 18, 24 months, and final follow-up were comparable between groups. Hypofractionated GKRS led to greater symptomatic improvement (37.5% vs. 12.5%, $p = 0.043$) without increased complications. Tumor control was 100%, with no additional treatments required.

Conclusions: Hypofractionated GKRS achieves comparable volumetric outcomes to single-fraction GKRS, with greater symptomatic improvement and no additional complications. Given its benefits for larger tumors, it represents a valuable treatment option for Koos grade III and IV vestibular schwannomas.

OP-025

ORAL PRESENTATION - INTRACRANIAL VESTIBULAR SCHWANNOMAS
01-06-2026 17:15 - 18:15

EARLY VOLUMETRIC REDUCTION AFTER GAMMA KNIFE RADIOSURGERY IN NEWLY DIAGNOSED CYSTIC VESTIBULAR SCHWANNOMA OF KOOS GRADE III–IV.

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Introduction:
The role of Gamma Knife radiosurgery (GKRS) for large vestibular schwannomas (VS) classified as Koos grade III–IV remains controversial, particularly for patients with cystic VS, which are often managed by microsurgical resection. This study aimed to evaluate the volumetric response of cystic VS compared with solid VS following GKRS in patients with newly diagnosed, non-surgically treated Koos grade III–IV tumors.

Methods:
This retrospective study included patients with newly diagnosed Koos grade III–IV VS treated with GKRS between January 2014 and December 2024, with > 6 months of radiological follow-up. Local control (LC) was defined as the absence of need for additional treatment (surgical resection or second GKRS). Tumors were categorized as cystic or solid based on MRI characteristics. Volumetric analysis using Leksell Gammaplan was performed at early (3–6 months), intermediate (12–18 months), and late (>24 months) follow-up. Volumetric changes relative to pre-GKRS volume were compared between cystic and solid VS using the Mann–Whitney U test, with $p < 0.05$ considered significant.

Results:
A tottal of 81 VS (15 cystic, 66 solid) were included in the study. The mean follow-up period was 47.4 months. The LC rate was 100% in cystic VS and 98.5% in solid VS. Cystic VS demonstrated significantly greater tumor volume reduction than solid VS at early (median −9.5%, range −28.8 to +26.2%; $p = 0.046$) and intermediate follow-up (median −31.4%, range −79.0 to +1.2%; $p = 0.020$), while no significant difference was observed at the late scan ($p = 0.18$). At the last follow-up, the cystic VS showed a significantly higher proportion of tumors with volume reduction from their pre-GKRS volume compared with the solid VS ($p = 0.21$, Fisher's exact test; odds ratio = 2.8, 95% CI = 0.67–13.4).

Conclusion:
Large cystic VS showed earlier and greater volumetric reduction following GKRS. GKRS could be considered a less invasive option for large cystic VS often surgically resected.

OP-026

ORAL PRESENTATION - INTRACRANIAL VESTIBULAR SCHWANNOMAS
01-06-2026 17:15 - 18:15

SUBTOTAL RESECTION WITH ADJUVANT RADIOSURGERY VERSUS GROSS TOTAL RESECTION FOR LARGE VESTIBULAR SCHWANNOMAS: COMPARATIVE OUTCOMES IN CRANIAL NERVE PRESERVATION AND TUMOR CONTROL

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Savi Agarwal, Anubhav Chandla, Yelena Malkhayasan, Isaac Yang

Introduction: The optimal management practices for large vestibular schwannomas (VS), or those greater than >2.5cm, remain in debate, particularly considering the compromise between extent of resection and functional outcomes. While gross total resection (GTR) maximizes tumor removal, there is an associated risk to cranial nerve function. Planned subtotal resection (STR) followed by stereotactic radiosurgery (SRS) has emerged as an alternative, but there is a lack of comparative data. We compare functional and oncologic outcomes between GTR and STR with adjuvant SRS in the management of large vestibular schwannomas.

Methods: We performed a retrospective cohort study of patients with VS >2.5 cm treated at UCLA Medical Center between 2010 and 2021. Patients were grouped into GTR or STR+SRS cohorts. Primary outcomes included facial nerve function , hearing preservation , and vestibular function at last follow-up. Secondary outcomes included tumor control (serial imaging), reoperation rates, and complications. Multivariable logistic regression was used to adjust for baseline characteristics such as age, tumor size, and preoperative function.

Results: 108 patients were included (GTR: n=62; STR+SRS: n=46), with average follow-up of 5.3 years. Both facial nerve preservation (89% vs. 56%, p = 0.01) and hearing preservation (37% vs. 13%, p=0.04) were significantly higher in the STR+SRS group vs. GTR. Vestibular dysfunction was less frequent for STR+SRS (42% vs. 65%, p=0.03). Tumor control was comparable between groups (STR+SRS: 78%; GTR: 90%, p=0.37). Reoperation rates (p=0.72) and complications (p=0.14) were not significantly different. STR+SRS patients reported faster return to baseline function and improved quality-of-life on follow-up (p=0.02).

Conclusion: Planned STR followed by adjuvant SRS for large VS offers superior cranial nerve preservation compared to GTR, with equivalent tumor control. These findings support a shift toward a staged, functional preservation paradigm for the management of large vestibular schwannomas.

OP-027

ORAL PRESENTATION - INTRACRANIAL VESTIBULAR SCHWANNOMAS
01-06-2026 17:15 - 18:15

TUMOUR, TREATMENT, AND TRANSFORMATION: A PROSPECTIVE STUDY OF QUALITY OF LIFE TRAJECTORIES IN VESTIBULAR SCHWANNOMA

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OBJECTIVE With mortality for vestibular schwannoma (VS) now negligible, treatment success is increasingly defined by health-related quality of life (HRQOL). This prospective study evaluated HRQOL outcomes after microsurgery (MS) and Gamma Knife radiosurgery (GKRS), and identified clinical and psychosocial predictors of poor HRQOL.

METHODS We conducted a prospective observational study of 110 sporadic nonsyndromic VS patients treated at PGIMER, Chandigarh, between 2018-2020: MS (n=38), GKRS-primary (n=45), and GKRS-secondary (n=27). Patients were comprehensively assessed for clinical, radiological, cognitive, and psychosocial factors, and QOL via validated instruments (SF-36, PANQOL) at baseline and 6, 12, and 24 months.

RESULTS Baseline determinants of poor HRQOL were headache, vertigo, imbalance, and tinnitus (all $p<0.05$). At baseline, profound hearing loss (WHO grade III/IV) affected up to 88.9% in secondary GKRS, 73.7% in MS, and62.2% in primary GKRS groups. Tinnitus and dizziness rates exceeded 50% in all groups, but severe facial nerve dysfunction (HB grade IV-VI) was notably higher in recurrent cases (up to 55%). Cognitive impairment ranged from 15.6-31.6% at baseline; memory impairment affected 55-60%. Depression (BDI) was present in 55.3% of MS,37.8% of primary GKRS, and 33.3% of secondary GKRS; anxiety ranged from 26.7-37%.At 24 months, facial nerve dysfunction, taste disturbance, and paraesthesia significantly impaired HRQOL in the MS cohort ($p<0.01$), while headache, tinnitus, and socioeconomic status influenced HRQOL in the GKRS cohort ($p<0.05$). Tumour volume and residual disease did not independently predict HRQOL ($p>0.1$). Compared with MS, GKRS preserved better emotional and social functioning ($p<0.05$).Overall, HRQOL improved in 74%, remained stable in 15%, and deteriorated in 11%.

CONCLUSIONS HRQOL is VS determined more by symptom burden and psychosocial context than by treatment modality or tumour volume. MS is associated with greater physical morbidity, whereas GKRS patients more frequently report tinnitus and imbalance. Incorporation of psychological support and systematic HRQOL monitoring is essential in long-term management.

OP-028

ORAL PRESENTATION - INTRACRANIAL BENIGN
03-06-2026 11:30 - 12:30

RE-IRRADIATION OUTCOMES FOLLOWING SALVAGE CONVENTIONALLY FRACTIONATED GAMMA KNIFE STEREOTACTIC RADIOTHERAPY (SFGK) TO RECURRENT PRIMARY NON-GLIAL BRAIN TUMOURS

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Purpose The objective of this retrospective study was to evaluate the efficacy and safety of salvage conventionally fractionated Gamma Knife (SFGK) re-irradiation for recurrent and previously irradiated primary non-glial brain tumours.

Patients and Methods Eligibility criteria comprised consecutive patients undergoing SFGK, from 2019 to 2024, to salvage a progressive and previously definitively radiated primary intracranial tumour. The primary endpoint was local progression-free survival (LPFS). Secondary endpoints included overall survival (OS) and safety. The equivalent dose in 2 Gy/day fractions (EQD2) was calculated using and a/b 2 for normal tissue and 10 for tumor.

Results Twenty-six patients (44 tumours) were treated. There were 34 meningiomas (77%), of which 28 were WHO Grade 2. The median time from prior radiotherapy was 50.4 months (IQR 19.7-86.8). The SFGK prescription dose was 50.4 Gy in 28 fractions in 37 tumours (84%). The median cumulative prescription EQD2 was 102.7 Gy (IQR 99.6-114.6) for those with one prior radiotherapy course. The median normal brain EQD2 was 99.2 Gy (97.9-117.5) for those with one prior radiotherapy course. The median follow-up was 18.1 months (IQR 10.5-28.2). Overall LPFS at 12 and 24 months was 91.0% (95% CI 73.6-97.2%) and 75.1% (95% CI 51.0-88.6%), respectively. OS at 12 and 24 months was 96.2% (95% CI 75.7-99.4%) and 83.2% (95% CI 54.8-94.6%), respectively. For the meningioma cohort, 12- and 24-month LPFS was 90.6% (95% CI 65.7-97.7%) and 74.1% (95% CI 42.7-90.0%), respectively. Grade 3 radionecrosis occurred in two patients (6.9%), one case of Grade 3 progressive intracranial hemorrhage (3.4%), and no Grade 4 or 5 events were observed.

Conclusion and Relevance This is the largest series of SFGK re-irradiation. Treatment is feasible and well tolerated, achieving durable local control in recurrent non-glial brain tumours with few serious adverse events despite high cumulative doses.

OP-029

ORAL PRESENTATION - INTRACRANIAL BENIGN
03-06-2026 11:30 - 12:30

LINAC BASED FRAMELESS SINGLE FRACTION VERSUS FRACTIONATED RADIOSURGERY FOR VESTIBULAR SCHWANNOMAS - A SINGLE INSTITUTION EXPERIENCE FROM A TERTIARY CANCER CENTRE ASSESSING HEARING PRESERVATION RATES , LOCAL CONTROL AND TOXICITY

Sanjay Hunugundmath[1], Mariya Deputy[2], Amit Nirhali[1,2], Shreya Dwide[1,2]
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INTRODUCTION With the evolution of non-invasive treatment modalities, stereotactic radiosurgery (SRS) and fractionated stereotactic radiotherapy (FSRT) have emerged as effective alternatives to microsurgical resection, in the management of vestibular schwannomas. The treatment of VS often must balance a goal of tumour control with hearing preservation and other potential side effects. In this study, we retrospectively analysed clinical outcomes between SRS and FSRT with the aim to compare efficacy, safety profiles and hearing preservation rates between these two approaches.

METHODS AND MATERIALS This is a retrospective analysis of patients 50 treated between June 2019 to May 2025. The data was collected from the hospital EMR Data Radiological diagnosis of vestibular schwannoma was confirmed on MRI imaging. Patients were classified into serviceable and non serviceable hearing loss based on Gardner- Robertson grade. Hearing preservation was defined as maintaining Gardner-Robertson Class I–II at last follow-up. Preservation rates between single-fraction SRS and fractionated SRT were compared using the chi-square test.

RESULTS The median follow up was 48 months (6 – 72 Months). Of 50 patients 20 had a dose of 12Gy single fraction and 30 patients had a dose of 25Gy in 5 fractions. The median volume of FSRT group and SRS group was 8.46cc and 1.40 cc.No significant difference between SRS and FSRT were found with respect to hearing preservation(p=0.90).The significant predictors were the cochlear dose and the pretreatment hearing status The local control at a 2, 3 and 4 years were 100, 92, and 90 % respectively, in both the groups(0.99). Treatment-related toxicity was mild or moderate, in general not exceeding National Cancer Institute Common Terminology Criteria for Adverse Events grade 2.

CONCLUSION Single-fraction radisuregery and FSRT for 5 fractions provide similar clinical and radiographic local control, while maintaining similar hearing preservation rates, in the treatment of VS.

OP-030

ORAL PRESENTATION - INTRACRANIAL BENIGN
03-06-2026 11:30 - 12:30

EFFICACY AND SAFETY OF STEREOTACTIC RADIOSURGERY AS A PRIMARY TREATMENT FOR CENTRAL NEUROCYTOMA: FROM SINGLE-FRACTION TO STAGED HYPOFRACTIONATION STRATEGIES.

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[1]Huashan Hospital, Fudan University; National Center for Neurological Disorders, Cyberknife Center, Neurosurgical Department, Shanghai, China, [2]Shanghai Gamma Knife Hospital, Gamma Knife Center, Shanghai, China

Objective: Central Neurocytoma (CNC) is a rare benign intraventricular tumor typically treated with microsurgical resection. However, surgery is associated with significant risks, including hemorrhage, infection, and cognitive deficits, and gross total resection (GTR) remains challenging. This study aims to evaluate the safety, efficacy, and feasibility of stereotactic radiosurgery (SRS) as a first-line treatment for CNC patients, specifically exploring optimized strategies for large-volume lesions.

Methods: We retrospectively analyzed 28 patients with CNC treated with first-line SRS at Huashan Hospital between May 2019 and August 2025. Patients were treated using either Gamma Knife (GK) or CyberKnife (CK) as first line tretment. Treatment strategies were stratified based on tumor volume: single-fraction SRS was generally used for small lesions (<10 cm^3), while fractionated SRS (FSRS) or staged SRS strategies were employed for larger lesions (≥10 cm^3) . The primary endpoints were local tumor control and overall survival (OS). Secondary endpoints included clinical symptom improvement and toxicity.

Results: The cohort (median age 32) had a median tumor volume of 15.4 cm^3 (range: 1.4–57.0 cm^3). At a median follow-up of 18 months, OS was 100% with no recurrences. 28% achieved Partial Response and 72% Stable Disease. Symptomatic improvement was reported in 71% of patients. Notably, for large tumors (≥10 cm^3), fractionated and staged strategies demonstrated significant tumor shrinkage trends comparable to single-fraction outcomes for smaller lesions. The complication rate was 10% (3/28), all successfully managed.

Conclusion: SRS is a safe and effective first-line alternative for CNC. The implementation of diverse strategies, particularly fractionated and staged modalities, offers a promising approach for managing large-volume CNCs with acceptable toxicity . Based on these preliminary findings, a multi-center prospective clinical trial (Target N=90) is currently under preparation to further validate this volume-adapted SRS
strategy.

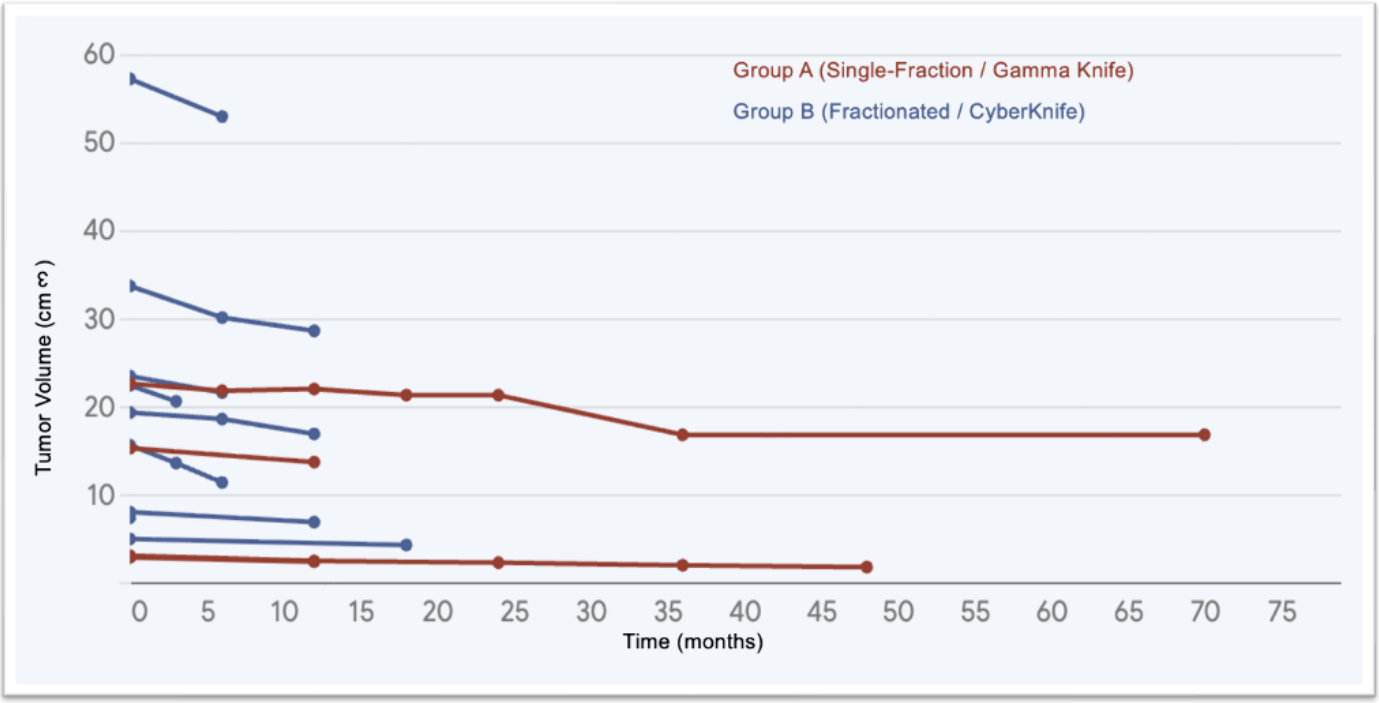

Figure 1. Comparison of volumetric response between Single-fraction (GK) and Fractionated (CK) SRS. Spaghetti plot illustrating longitudinal tumor volume changes. **(Blue lines)** represent single-fraction SRS (GK, 12-14Gy/1fx), and **(Red lines)** represent fractionated SRS (CK, 15.9-20Gy/3-4fx). The dashed line marks the 10 cm³ volume threshold. **Note distinct response patterns based on tumor size:** **(1) For small lesions (<10 cm³):** Both modalities demonstrate similar regression trajectories, indicating comparable efficacy. **(2) For large lesions (≥10 cm³):** Fractionated SRS (Red) exhibits a more pronounced shrinkage trend compared to single-fraction treatment, suggesting that fractionation allows for sufficient dose delivery to achieve superior control in bulky tumors.

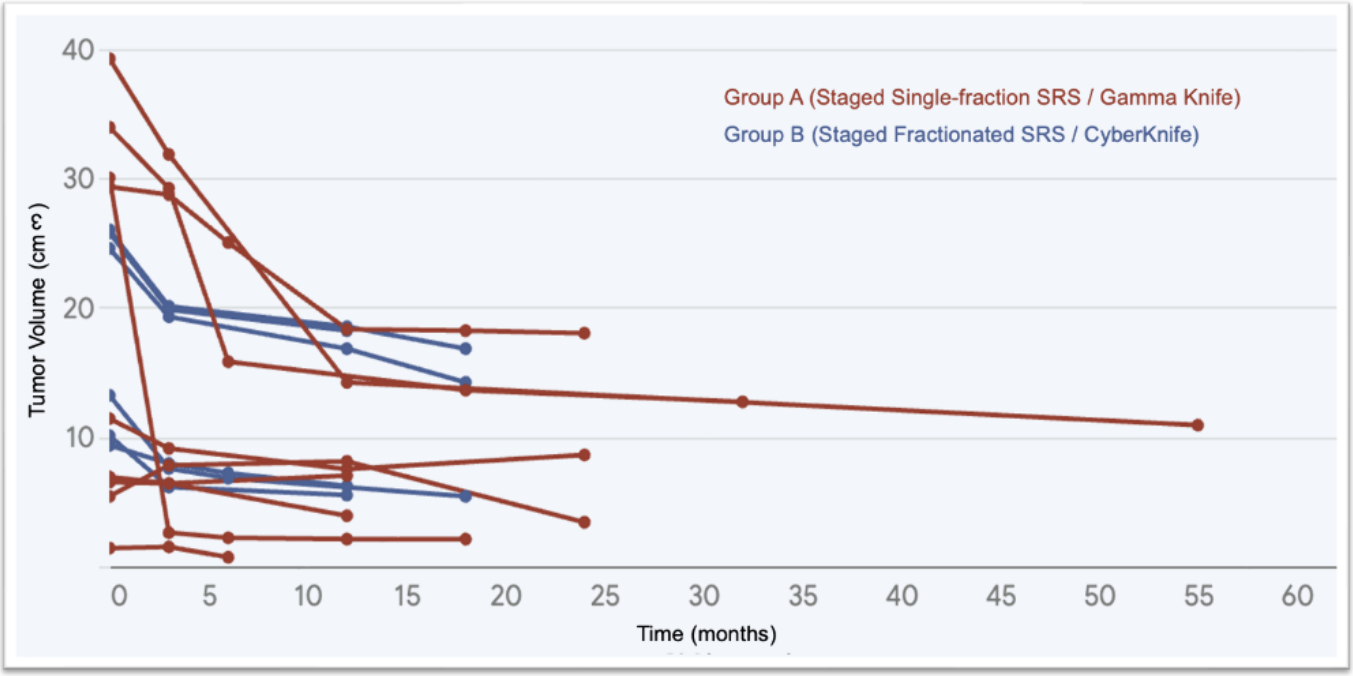

Figure 2. Longitudinal volumetric response following Staged Stereotactic Radiosurgery (SRS) strategies. Comparison of tumor regression trajectories between two staged protocols. **(Blue lines)** represent **Staged Single-fraction SRS** (Gamma Knife), typically administering 6.5–9 Gy per stage (50–54% isodose). **(Red lines)** represent **Staged Fractionated SRS** (CyberKnife), consisting of an initial stage (5 Gy × 4 fractions) followed by a second stage (5 Gy × 3 fractions) (63–68% isodose). **Key observations: (1)** Both staged strategies demonstrate comparable efficacy trends, achieving significant volume reduction in large-volume CNCs (≥10 cm^3). **(2)** The marked downward trajectory highlights that staged treatment is a feasible and effective strategy for overcoming the radioresistance often associated with large, bulky lesions.

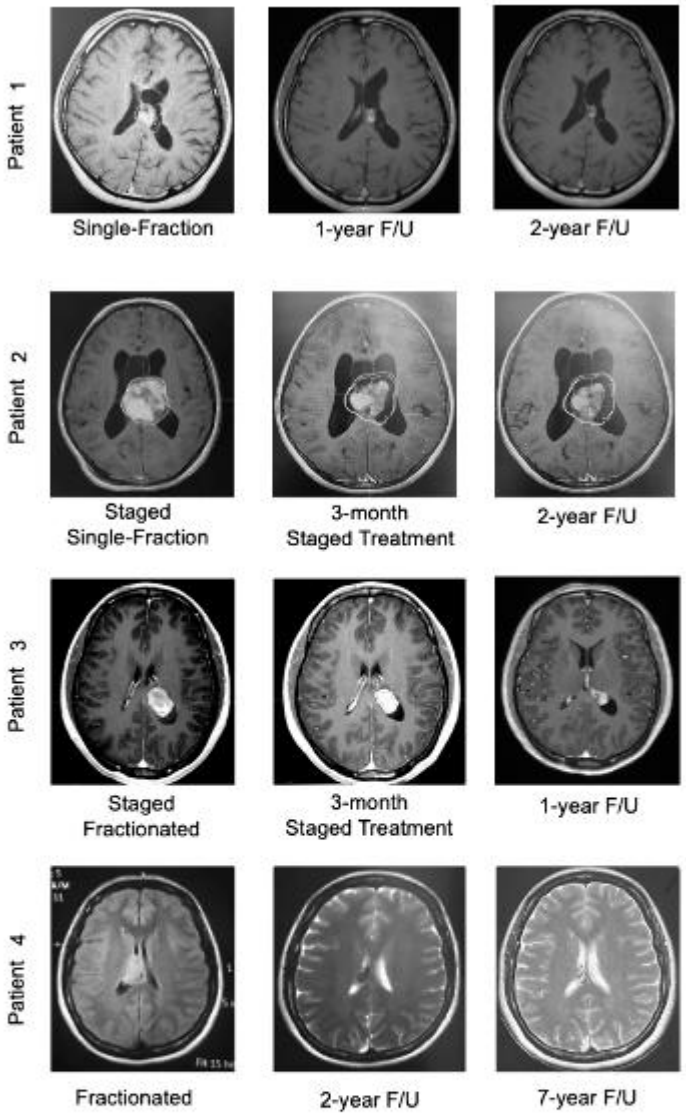

Figure 3. Longitudinal outcomes stratified by SRS treatment strategy.

•**Patient 1 (Single-Fraction):** Treated with 14 Gy , 50%. Shows excellent regression at 2 years.

•**Patient 2 (Staged Single-Fraction):** Large target treated in two stages (14 Gy, 50% each), separated by 3 months. Shows successful debulking of the large mass.

•**Patient 3 (Staged Fractionated):** Treated with CyberKnife in two stages (Stage I: 5 Gy × 4fx, 68%; Stage II: 5 Gy × 3fx, 66%). Shows early rapid regression at 1 year.

•**Patient 4 (Fractionated):** Treated with 22 Gy in 4 fractions (5.5 Gy × 4fx, 65%). Shows durable long-term control at 7 years post-treatment

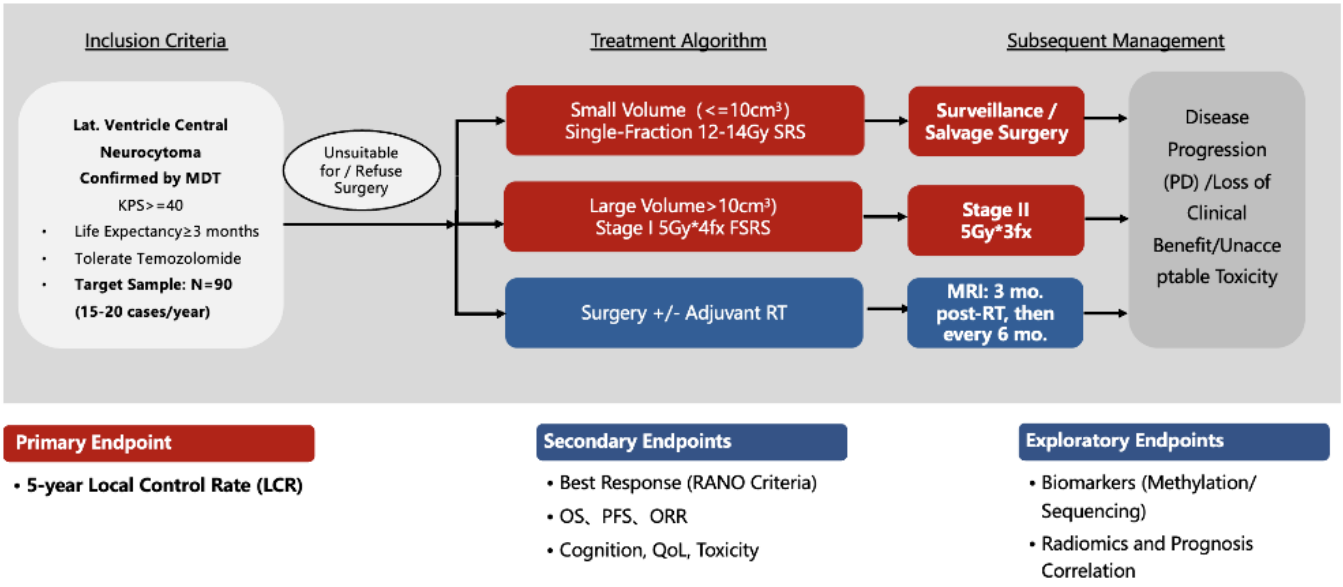

Figure 4. Study Design of the Multicenter Exploratory Prospective Clinical Trial for First-line Radiosurgery in Central Neurocytoma (The Huashan Protocol).

The study targets 90 patients with MDT-confirmed Central Neurocytoma, primarily encompassing those unsuitable for or refusing microsurgical resection. Treatment Stratification: Patients are stratified by tumor volume with a cutoff of 10 cm^3.
(1) Small Volume Cohort (<= 10 cm^3): Receives standard single-fraction SRS (12–14 Gy).
(2) Large Volume Cohort (> 10 cm^3): Undergoes a novel Staged Hypofractionated SRS regimen (Stage I: 5Gy * 4fx followed by Stage II: 5Gy * 3fx). A parallel surgical cohort serves as a control.
Endpoints: The primary endpoint is the 5-year Local Control Rate (LCR). Secondary endpoints include Overall Survival (OS), Progression-Free Survival (PFS), and Quality of Life (QoL). Exploratory analyses will investigate molecular biomarkers and radiomic features to predict treatment response.

Table 1. Patient characteristics: descriptive statistics (total cases = 28)

Parameter	N	%
Gender		
Male	13	
Female	15	
Age, years		
Median	32	/
Range	13 – 64	/
Clinical Symptoms		
No obvious symptoms	7	25
Headache/Dizziness	13	46
Nausea/vomiting	8	30
Memory impairment	1	4
Other neurological deficits	6	20
KPS at RT		
Median	70	/
Range	60 –100	/
Location of lesions		
Lateral ventricles	18	64
Lateral & 3th ventricles	10	36
Diagnosis		
Imaging (no histology)	28	100
SRS Strategy		
Single-fraction	4	14
Staged	9	32
Fractionated	9	32
Fractionated Staged	6	22
Total	28	100

Table 2. Treatment Parameters and Outcome (N=28)

Parameter	N	%
Clinical status		
Improved	20	71
No Change/	8	29
PTV		
Median	15.4	/
Range	1.4 – 57.0	/
Image outcome: RANO criteria		
Complete response	0	0
Partial response	8	28
Stable disease	20	72
Recurrence and survival		
Local recurrence	0	0
Distant recurrence	0	0
Death	0	0
Total	28	100

OP-031

ORAL PRESENTATION - INTRACRANIAL BENIGN
03-06-2026 11:30 - 12:30

LONG TERM FOLLOW UP FOR MENINGIOMA PATIENTS AFTER SRS: COGNITIVE AND QUALITY OF LIFE (QOL) DATA

Anna Bangiri[1,2], Stefan Pszczolkowski[2], Michael Baliousis[3], Stefanie Thust[2], Paul Morgan[2]
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Aim To assess cognitive and QoL changes in meningioma patients that have undergone Stereotactic Radiosurgery (SRS) treatment. We present the results from the retrospective cohort of the CoDe-B-Rad Study (NCT06466720).

Methods Twenty meningioma patients were recruited retrospectively in the CoDe-B-Rad study. All participants were treated at least one year prior to testing. The Montreal cognitive assessment (MoCA) was used along with QoL questionnaires QLQ-C30 and BN20. Participants were asked to complete the QLQs twice: (1) at time of testing and (2) think back to how they felt prior to treatment. Normative data for the MoCA was used to define cut-off points for mild cognitive impairment (MCI). These were stratified based on age and education level. A difference of more than 3 points on the MoCA from normative data, and 10 points in the pre- and post-treatment QLQ scores was considered clinically significant.

Results Participants' mean age at consent was 65.9 (range: 43-83). Seventeen (85%) participants had MCI at the time of testing. For nine (45%) the difference was significant. Only two (10%) of participants scored below 10 in the Memory Index Score. The mean GlobalHealthStatus (GSH)/QoL (±SD) for the cohort was 62.5 (±22.9) compared to 71.2 (±22.4) for the general population. The mean and median change in GHS/QoL between pre- and post-treatment was 0.00 (±32.4). Six (30%) and four (20%) participants saw a significant deterioration and improvement respectively in their GSH/QoL post-treatment. There was no significant change in the medians of the functioning scales. Median fatigue showed a significant increase for the cohort.

Conclusion Results from the retrospective cohort of the CoDe-B-Rad study suggests that approximately 85% of patients that receive SRS develop MCI more than a year post treatment. The cohort's mean and median GHS/QoL remain unchanged with fatigue the only symptom scale with a significant deterioration post treatment.

OP-032

ORAL PRESENTATION - INTRACRANIAL VASCULAR
03-06-2026 11:30 - 12:30

BEYOND THE BOTTLENECK: A MODERN, FRAMELESS WORKFLOW FOR SCALABLE AND ADVANCED CEREBRAL AVM RADIOSURGERY

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Objective Traditional frame-based approaches to Stereotactic Radiosurgery (SRS) for cerebral Arteriovenous Malformations (AVMs) create logistical bottlenecks. These bottlenecks include time-pressured planning and limited availability of angiography suite. We describe a comprehensive, frameless workflow to modernize our service, drawing on over 35 years and thousands of cases of SRS experience.

Methods Patients are immobilized using a mask-based system. Our workflow integrates multi-modality diagnostic imaging, including Time-of-Flight MRA, CTA, and 2D DSA. Volume delineation begins with an estimate on orthogonal 2D DSA images, which is then projected onto and manually refined against 3D image sets. Treatment planning is performed with a zero-margin philosophy. We describe our strategies for handling complex cases, including large niduses (requiring volume staging), the presence of embolization and the use of advanced planning tools to optimize dose distribution. Image fusion accuracy was assessed on a patient-specific basis by measuring displacement between internal anatomical features.

Results Since implementing the frameless workflow in 2023, we have treated 93 niduses in 80 patients (mean age: 41.6 years, range: 7-76; volumes: 0.03-44.2 cc, mean: 3.9 cc). Volume staging was performed in 18 patients (2 or 3 stages).
The service previously averaged 3 patients per month; the frameless workflow has demonstrated a capacity of up to 8 patients per month.
Patient-specific image fusion accuracy was assessed using 498 internal anatomical markers, demonstrating a median 3D vector displacement of 0.71 mm (SD: 0.29 mm). 79.5% of all points showed agreement ≤1mm.

Conclusion The implementation of a frameless SRS workflow for AVMs is feasible, highly accurate, and efficient. This approach allows for the decoupling of simulation and treatment, supports the integration of multi-modality imaging, and provides the flexibility to manage complex cases. This modernized, end-to-end process has resolved previous service bottlenecks and established a robust, scalable program for AVM radiosurgery.

OP-033

ORAL PRESENTATION - INTRACRANIAL VASCULAR
03-06-2026 11:30 - 12:30

SEIZURE OUTCOMES AFTER LINAC RADIOSURGERY FOR UNRUPTURED BRAIN ARTERIOVENOUS MALFORMATIONS: A 7-YEAR RETROSPECTIVE COHORT STUDY

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Background: Epileptic seizures are the second most common presentation and the leading clinical manifestation in unruptured brain arteriovenous malformations (BAVMs), occurring in 20–45% of patients. This study aimed to determine the proportion of patients with epilepsy secondary to unruptured BAVMs who achieved adequate seizure control (Engel I) after linear-accelerator (LINAC) radiosurgery (RS).

Methods: We conducted a retrospective longitudinal observational analytical study of a single cohort. From 444 cases treated with RS over a 7-year period, we included patients with unruptured BAVMs, with seizures as their initial manifestation, without prior microsurgery or endovascular therapy, and with at least 2 years of clinical follow-up. Demographic variables, Spetzler–Martin (SM) grade, location, radiation dose, seizure frequency before and after treatment, number of antiseizure medications (ASMs), and Engel classification at 2 years were collected. Statistical analysis was performed using SPSS v25.

Results: Thirteen patients with 14 BAVMs met inclusion criteria. Mean age was 31 years (range 15–57); 7 were female (53.8%). Seizure types included focal (46.2%), generalized (38.4%), and mixed (15.4%). SM grades were II in 8 lesions (57.2%), III in 4 (28.6%), I in 1 (7.1%), and IV in 1 (7.1%). SM grade showed moderate correlation with significant seizure reduction (>50%; r=0.568, p=0.031). RS was delivered with a Varian TrueBeam LINAC: 12 lesions (85.7%) received single-session treatment, and 2 underwent hypo fractionated. At 2 years, 9 patients (69.2%) achieved Engel IA, and the remaining 4 achieved Engel IB–ID. Significant reductions were found in seizure frequency (p=0.003) and number of ASMs (p=0.008) after treatment.

Conclusion: LINAC-based radiosurgery provided substantial seizure control in patients with epilepsy due to unruptured BAVMs, with nearly 70% achieving Engel IA at 2 years. These results support RS as an effective therapeutic option and suggest that SM grade may influence seizure outcomes.

OP-034

ORAL PRESENTATION - INTRACRANIAL VASCULAR
03-06-2026 11:30 - 12:30

GAMMA KNIFE RADIOSURGERY OF ARTERIOVENOUS MALFORMATIONS: SUMMARY OF EXPERIENCE IN 15 YEARS AT CHO RAY HOSPITAL

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Objectives: The authors analyzed the clinical, neuroimaging outcomes and complications that occur 1 or more years of patient with cerebral arteriovenous malformation after Gamma Knife radiosurgery, focusing on the analysis of the oblitergation rate depending on the AVM volume and AVM grades.

Methods: Between 2006 and 2021, 870 patients with cerebral AVMs were treated with Gamma Knife radiosurgery(GKRS) and follow up by Stata tatistical analysis. The mean age was 32,195 ± 14,270 (5-78), the mean volume 9,947 ± 12,360 cm^3 (0,019 - 121,570 cm^3), the mean marginal dose was 20,373 ± 3,241 Gy (14-26), and the mean follow up duration was 49,647 ± 22,571 months (6-103).

Results: The angiographic obliteration rate was 66,55% overall. Obliterated time 21,128 ± 13,771 months. The overall bleeding rate was 2,41%.

Conclusions: Gamma Knife radiosurgery is a safe and effective treatment for selected patients with AVMs, and it carries a low risk of first hemorrhage from brain arteriovenous malformations and damaging adjacent critical vascular structures.

OP-035

ORAL PRESENTATION - INTRACRANIAL VASCULAR
03-06-2026 11:30 - 12:30

NAVIGATING MANAGEMENT OF HIGH-GRADE AVMS: RESULTS AND RISK STRATIFICATION IN HYPOFRACTIONATED GAMMA KNIFE RADIOSURGERY

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Background: High-grade intracranial arteriovenous malformations (AVMs, Spetzler-Martin grades 4-5) remain among the most formidable challenges in neurosurgical practice. Hypofractionated Gamma Knife radiosurgery (hf-GKRS) has emerged as a promising alternative, aiming to increase obliteration rates and reduce complications by spreading dosing over several sessions.

Objective: This study critically evaluates the safety, efficacy, and outcome predictors for hypofractionated Gamma Knife radiosurgery (hf-GKRS) in treating high-grade AVMs. Specifically, the predictive utility of radiosurgery grading scales, including the modified Pollock-Flickinger (mPF) and modified radiosurgery-based AVM scale (mRBAS), is examined. Methods: A retrospective observational cohort of 36 patients with SMG 4-5 AVMs, treated between 2009 and 2020, was analyzed. Selection criteria included symptomatic bleed or progressive neurological decline and >2 years post-GKRS follow-up. Treatment comprised 2-5 fraction GKRS protocols (mean total dose 27 Gy, mean nidus volume 15.58 cc) with multidisciplinary input. Outcomes measured included AVM obliteration rates (complete/partial), functional status (pre- and post-GKRS mRS), complications, medication requirements, and the role of radiosurgery grading scales.

Results: After a median 38.6 months follow-up, complete AVM obliteration was achieved in 50%, with 91% experiencing >50% nidus reduction. Functional outcomes improved significantly (mean mRS reduction from 1.47 to 0.53, p=0.026), with minimal procedure-related disability. Radiological changes occurred in 55%, but only 13.8% were symptomatic. Interval hemorrhage and mortality rates were low (8.3% and 2.8%, respectively). Medication use post-GKRS was significantly linked to larger nidus volumes (p=0.009). No clinical or dosimetric variable significantly predicted time to obliteration or risk of complications in multivariate analysis. Comparative discussion highlights similar or better functional results and complication profiles relative to volume-staged radiosurgery strategies cited in literature.

Conclusion: hf-GKRS is validated as a safe, feasible, and moderately effective intervention for high-grade AVMs, with functional recovery and acceptable complication rates. Judicious candidate selection and use of radiosurgery grading scales are essential for optimizing outcomes.

OP-036

ORAL PRESENTATION - INTRACRANIAL VASCULAR
03-06-2026 11:30 - 12:30

STEREOTACTIC RADIOSURGERY FOR SPINAL CORD ARTERIOVENOUS MALFORMATIONS

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Background: Stereotactic radiosurgery (SRS) is a standard of care for intracranial arteriovenous malformations (AVMs). The tolerance of the spinal cord to SRS is perceived to be a barrier to the successful treatment of intramedullary spinal cord AVMs (scAVM). We report updated safety and efficacy outcomes, as well as spinal cord dosimetry, of patients with scAVM treated with SRS.

Methods: Patients with scAVM treated with SRS from 2000-2024 at a single institution were retrospectively analyzed. Demographics, treatment and dosimetric characteristics, hemorrhage events, and post-SRS toxicity were extracted. Obliteration status was determined from spinal angiography.

Results: 58 patients were included with a median age of 28 years (range 6-62 years). Nine patients underwent a second course of SRS to treat persistent scAVM. Median dose was 20 Gy in a median of 2 fractions targeting a median AVM volume of 1.49cc. Prior to SRS, 57% experienced hemorrhage. Treatment prior to SRS included 31% (18/58) with embolization, 10% (10/61) with surgery, and 7% (4/58) with both. With a median follow-up after SRS of 57 months (range 6-280 months), 29% (17/58) had a >50% decrease in the AVM size; 24% (14/58) with complete obliteration at a median time of 38.7 months. Only 2 patients experienced hemorrhage after SRS. In those treated with one course of SRS, spinal cord T2 signal developed in 15% of evaluable patients (7/46) at a median of 11.8 months; 3 had G1 (asymptomatic), 4 had grade 2 (requiring steroids). 54 patients had stable or improved symptoms after SRS. Spinal cord dosimetry will be presented.

Conclusion: Although only 24% of patients had a complete obliteration, SRS appears to decrease the incidence of hemorrhage, which occurred in 57% prior to SRS and only 3% after SRS. Similar to intracranial AVMs, SRS is a standard of care option for patients with spinal cord AVMs.

OP-037

ORAL PRESENTATION - EXTRACRANIAL SPINE
03-06-2026 11:30 - 12:30

DOSE-ESCALATED SINGLE FRACTION SPINE STEREOTACTIC RADIOSURGERY FOR CHORDOMA OF THE MOBILE SPINE OR SACRUM: LONG-TERM RESULTS

Amol Ghia[1], Martin Tom[2], Claudio Tatsui[3], Jing Li[2], Thomas Beckham[2], Chenyang Wang[1], Subha Perni[2], Anthony Conley[4], Brian De[2], Andrew Bishop[5], Mary Frances Mcaleer[2], Dennis Mackin[6], Behrang Amini[7], Laurence Rhines[3]
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Purpose: The purpose of this study is to report the long-term single-institution results of dose-escalated single-fraction spine stereotactic radiosurgery (SF-SSRS) for chordoma targets of the mobile spine and sacrum.

Methods: This is a single-institution retrospective review of 15 patients (16 sites) with primary or metastatic chordoma of the mobile spine and sacrum treated with SF-SSRS to a GTV dose of 24 Gy from 2014-2019 reporting local control (LC), overall survival (OS) and late toxicities.

Results: Of the 15 patients, 14 were male, and the median age was 70 years (range 36-76 years). Indications included definitive SF-SSRS to the primary site (Group 1, n=6), salvage SF-SSRS for locoregional recurrence following en bloc resection (Group 2, n=6), or SF-SSRS for distant spinal metastasis (Group 3, n=3). Group 2 patients were treated with salvage SF-SSRS at a median of 29 months (range 20-87 months) after initial en bloc surgery. The median OS for the cohort was 82 months. Of the 16 sites, 9 were pelvic targets. Two Group 3 sites underwent laser interstitial thermal therapy in addition to SSRS to address epidural disease. With a median imaging follow-up of 65 months, the median LC for the entire cohort was 92 months while the 5-year and 7-year LC was 82% and 52%, respectfully. For Group 1 sites, the median LC was 111 months. There were a total of 7 local failures (LF) of which 5 occurred >4 years post-SSRS. Four LFs were in-field while 3 were marginal (1 epidural, 2 CTV). Four patients experienced Grade 3 fractures post-SSRS. No other Grade 3+ radiation related toxicities were noted.

Conclusions: SF-SSRS is an effective management tool in patients with mobile spine and sacral chordomas with an acceptable toxicity profile. Long-term follow-up is required for definitive intent cases as LF may occur >4 years post-SSRS.

OP-038

ORAL PRESENTATION - EXTRACRANIAL SPINE
03-06-2026 11:30 - 12:30

PREDICTORS OF VERTEBRAL COMPRESSION FRACTURE FOLLOWING STEREOTACTIC BODY RADIATION THERAPY IN SINS POTENTIALLY UNSTABLE SPINAL METASTASES

Laura Burgess[1,2], Eshetu Atenafu[3], K Liang Zeng[1], Hanbo Chen[1], Deepak Dinakaran[1], Chia-Lin Tseng[1], Jay Detsky[1], Hany Soliman[1], Joel Mullins[1], Jeremie Larouche[4], Christopher Witiw[5], Pejman Maralani[6], Cari Whyne[7,8], Michael Hardisty[7,8], Arjun Sahgal[1]
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Purpose: The Spinal Instability in Neoplasia Score (SINS) is the gold standard to determine if the metastatically involved spine is stable, potentially or frankly unstable. In potentially unstable spines, clarity is needed about the risk of post-SBRT vertebral compression fracture (VCF) and which patients may benefit from early stabilization. We aimed to identify predictors of VCF following spine SBRT in SINS potentially unstable patients, clarifying the treatment algorithm for this population.

Methods and Materials: A retrospective review of a prospectively maintained database of patients treated with SBRT for spinal metastases from January 2008 until December 2022. This analysis included only spine segments categorized as potentially unstable (SINS 7–12). The primary outcome was the rate of VCF.

Results: 524 patients with 976 treated spinal segments were SINS potentially unstable. 168/976 (17.2%) experienced a VCF after SBRT. 107/168 (63.7%) were iatrogenic and 61/168 (36.3%) concurrent with tumor progression. The 12-month incidence of iatrogenic VCF was 9.3% (95% CI 7.4%–11.5%) and 23.4% (95% CI 17.4%–29.9%) when concurrent with tumor progression ($p<0.0001$). Multivariable analysis confirmed iatrogenic VCF was associated with pre-existing VCF (HR 1.83, 95% CI 1.235–2.714, $p = 0.003$), no previous spine surgery (HR 1.67, 95% CI 1.024–2.710, $p = 0.040$), SINS total ≥10 (HR 1.68, 95% CI 1.122–2.512, $p = 0.012$) and an increasing D90 clinical target volume (CTV) in equivalent dose in 2Gy (EQD2; HR 1.03, 95% CI 1.010–1.055, $p = 0.004$). In the setting of concurrent tumor progression, only an increasing D90 to the CTV in EQD2 (HR 1.04, 95% CI 1.013–1.076, $p = 0.005$) significantly predicted for VCF.

Conclusions: Tumor control outweighs the risk of VCF associated with spine SBRT in potentially unstable metastases. Prophylactic stabilization could be considered in segments with a total SINS ranging from 10–12, a pre-existing VCF and when treating with high doses.

OP-039

ORAL PRESENTATION - EXTRACRANIAL SPINE
03-06-2026 11:30 - 12:30

OUTCOMES AND TOXICITIES OF SPINE STEREOTACTIC BODY RADIOTHERAPY (SBRT) IN PATIENTS TREATED WITH IMMUNOTHERAPY

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Background: Stereotactic Body Radiotherapy (SBRT) is being increasingly utilized in the treatment of metastatic disease of the spine while at the same time immunotherapy has a growing number of indications as systemic treatment for select primary malignancies. Outcomes and toxicities of spine SBRT in patients that receive immunotherapy remain unknown and warrant further evaluation.

Methods: Patient treated at a single institution with SBRT to a spinal metastasis between 2019 and 2024 were abstracted and evaluated for receipt of immunotherapy within 12 months of the date of their treatment. Outcomes including overall survival, local control, post-SBRT fracture rate, and CTCAE v. 5.0 toxicities were collected.

Results: During the evaluated period 54 patients were treated to 73 targets including 101 distinct vertebral bodies. The median clinical follow up for patients was 12 months with a median imaging follow up of 10 months. The median (IQR) radiation dose was 30 (25-30) Gy delivered over 1-5 fractions with a median Biologic Effective Dose (BED_{10}) of 48 (44-51) Gy. Over the follow up period there were 13 vertebral bodies that experienced fracture (12.7%) and there were 13 incidences of local recurrence (12.7%). There were no episodes of myelitis demonstrated and within 3 months of SBRT there were no grade 3 or greater episodes of colitis, dermatitis, or pneumonitis. There was no significant association with receipt of immunotherapy before or after SBRT and pain control or toxicities.

Conclusion: Spine SBRT in close timing with immunotherapy does not appear to increase risk for toxicities or discontinuation of therapy. There were acceptable rates of local control and post-treatment fracture similar to historical rates of SBRT alone.

OP-040

ORAL PRESENTATION - EXTRACRANIAL SPINE
03-06-2026 11:30 - 12:30

IMPACT OF CONTOURING GUIDELINE ADHERENCE ON PATTERNS OF FAILURE IN SACRAL SBRT

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Purpose: We previously demonstrated that adherence to sacral SBRT contouring guidelines is associated with a reduced risk of local failure. We speculated that this improved outcome was due to inclusion of guideline-recommended sectors that are at risk for subclinical disease. We present pattern of failure (POF) analyses to determine the anatomic and dosimetric impact of including vs. excluding recommended sectors in the sacral clinical target volume (CTV).

Methods and Materials: This was a subanalysis of a cohort of 215 sacral segments treated with SBRT between 2010–2021 at a single institution, of which 48 segments had MRI-based local failure and were included in this analysis. Failures were mapped according to the recurrence sectors (i.e., ala, vertebral body, posterior elements) and whether those sectors had been treated per guidelines (adherent) or recommended but not included in the CTV (non-adherent). For non-adherent segments, a dosimetric analysis compared the mean equivalent dose in 2-Gy fractions (EQD2, $\alpha/\beta=10$) delivered within treated sectors vs those non-adherent.

Results: Most metastases involved S1 (42%, 21/48) and S2 (31%, 15/48), were radioresistant (54%, 26/48) and had baseline extra-osseous extension (71%, 34/48). Sixty-nine percent (33/48) of segments were adherent to guidelines, while 31% (15/48) non-adherent. Among adherent segments, 91% (30/33) failed exclusively within adherent sectors, whereas 9% (3/33) failed concurrently in adherent and guideline-non-recommended sectors (1/33) or exclusively in non-recommended sectors (2/33). Among non-adherent segments, 73% (11/15) failed within non-adherent sectors: 3 isolated within the non-adherent sectors and 8 concurrently within adherent and non-adherent sectors. The mean EQD2 within the non-adherent treated CTV was 48.2 Gy (IQR, 46.6–49.4) vs. 38.7 Gy (IQR, 24.3–41.1) in sectors that should have been included in the CTV ($p<0.001$).

Conclusion: Non-adherent sacral SBRT contours results in a high risk of failure in excluded and consequently under-dosed guideline-recommended sectors, supporting the adoption of established guideline-based contouring.

OP-041

ORAL PRESENTATION - EXTRACRANIAL SPINE
03-06-2026 11:30 - 12:30

RAPID AUTOMATIC HIGH QUALITY STEREOTACTIC SPINAL RADIOSURGERY PLANNING BY ADAPTING LIBRARY PLAN

Wenhua Cao[1], Dennis Mackin[1], Tina Briere[1], He Wang[1], Dong Joo Rhee[1], Jing Li[2], Amol Ghia[2], Xin Wang[1]
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Objectives The main objective of this study was to demonstrate the capability of rapidly generating high quality stereotactic spinal radiosurgery (SSRS) treatment plans using automated planning and library plan.

Methods and Materials Two T10 cases with the GTV involving the right pedicle and posterior quadra of the vertebral body were retrospectively identified for the demonstration. Each had a single fraction clinical plan to cover GTV in 24 Gy and CTV in 16 Gy. The case with superior spinal cord sparing in the clinical plan was selected as the library plan. Using RayStation treatment planning system, we followed a 3-steps process to rapidly generate a new plan (termed rapid-plan) in the other case: first, the library plan dose was deformed to the other case as the predicated dose; second, “RayStation Automated planning” mimicked the predicated dose to a deliverable rapid-plan; finally, we fine turned the rapid-plan “on 2 clinical goals of spinal cord Dmax(0.01cc) < 15 Gy and GTV Dmin > 14Gy. The time of each step in the rapid planning was recorded. The quality of rapid-plan was compared to the clinical plan in both target coverage and OAR sparing.

Results The total time of the rapid planning took about 20 minutes. Half of the time was spent in step 1 due to some manual check on the deformable registration. Step 2&3 were fully automatic, and each was under 5 minutes. The rapid-plan was superior to the clinical plan in both target coverage and OAR sparing. Most noticeable, GTV volume got 24 Gy increased from 76.5% to 84.8%. Intermediate dose to the spinal cord dropped significantly with the maximum dose received by 1 cc spinal Cord decreased from 11.9 to 7.56 Gy.

Conclusion High quality SSRS plan can be achieved in minutes using predicated dose deformed from superior library plan.

OP-042

ORAL PRESENTATION - INTRACRANIAL PITUITARY/PARASELLAR
03-06-2026 12:30 - 13:30

MULTISESSION RADIOSURGERY FOR NON-FUNCTIONING PITUITARY ADENOMA: AN EXPLORATORY PROSPECTIVE STUDY.

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Introduction. Single-session radiosurgery (RS) is currently a well-established indication for the treatment of non-functioning pituitary adenomas (NFPAs), both in cases of residual or recurrent disease and in patients who are not candidates for surgery. Multi-session radiosurgery (mRS) is now considered for large adenomas or those located in close proximity to the optic pathways. The aim of this study is to evaluate the safety and efficacy of mRS.

Materials and Methods. In this prospective exploratory study, all patients with residual or recurrent non-functioning pituitary adenomas evaluated at our Institution and without specific contraindications were enrolled. All enrolled patients underwent mRS treatment using the CyberKnife system.
The primary endpoint of the study was the assessment of early and late post-treatment toxicity, with particular attention to cranial nerves and pituitary function. Secondary endpoints included local control and the impact of treatment on patients' quality of life (QoL).

Results. Between September 2020 and September 2023, 25 patients were enrolled and treated with mRS. All patients received a total dose of 25Gy, delivered in 5 fractions over 5 consecutive days. At the time of treatment, the patient age ranged from 19 to 79 years (median 54). The treated lesions had a median volume of 5.8cc (range 0.0.5-33). The median maximum point dose to the optic chiasm was 20.3Gy. The median maximum and average doses to the pituitary gland were 24.9Gy (range 6.3-31.2) and 18.1Gy (range 3.4-28.1), respectively.
After a mean follow-up of 34 months (range 4-44), one patient developed transient dysphagia and dysphonia, and four patients required minor adjustments to their hormone replacement therapy. Visual function was generally preserved, and none of the treated tumors showed radiological progression during the observation period.

Conclusions. Pending final results, this preliminary analysis supports the short-term safety and efficacy of mRS in the treatment of non-functioning pituitary adenomas.

OP-043

ORAL PRESENTATION - INTRACRANIAL PITUITARY/PARASELLAR
03-06-2026 12:30 - 13:30

GA-68 DOTATATE PET/CT ENHANCES TARGET DELINEATION IN DURAL STEREOTACTIC RADIOTHERAPY

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Purpose: Ga-68 DOTATATE PET/CT targets somatostatin receptors and provides high lesion-to-brain contrast in neuroendocrine tumors, offering potential advantage for evaluating intracranial and dural involvement. These biologic imaging characteristics may complement MRI for more precise target visualization. This study evaluates the role of Ga-68 DOTATATE PET/CT in improving target delineation for stereotactic radiotherapy(SRT) of dural metastasis.

Methods/Materials: Thirteen patients with dural lesions underwent SRT and had MRI and PET/CT prior to treatment planning. Eight patients(15 lesions) had Ga-68 DOTATATE PET/CT and five patients(6 lesions) had FDG F18 PET/CT, all within 3 months before the radiotherapy. All lesions were contoured on PET and MRI to generate GTV PET and GTV MRI, respectively. SUV of the lesions from the two PET modalities were compared using target-to-background contrast, and the delineated volumes on PET were compared to MRI-based contours. The clinical target volumes delineated by experienced radiation oncologists were also evaluated for potential SUV threshold to standardize contouring on Ga-68 DOTATATE PET/CT.

Results: Ga-68 DOTATATE PET/CT demonstrated substantially higher contrast of dural lesions with target-to-background SUV ratio of 20.6 (range 12.5-34.4), whereas F18 FDG PET/CT showed a ratio of 0.8 (range 0.4-1.6), which makes the lesion-brain boundary indistinct in most of the cases. For Ga-68 DOTATATE patients, the composite GTV volumes(PET + MRI) ranged from 0.13cc to 9.50cc. Of the 15 lesions, 8 had >30% of the composite volumes contributed by Ga-68 Dotatate PET/CT that were not detected on MRI alone. The maximum SUVs varied considerably(1.85-24.29) within the dural metastases. The common methods using fixed value threshold, 40% of SUVmax and background-dependent threshold were tested but not successful.

Conclusion: Ga-68 DOTATATE PET/CT provides superior complementary information to MRI for delineating dural metastasis in SRT planning compared with F-18 FDG PET/CT, suggesting improved target definition and potentially enhanced treatment accuracy. Additional prospective evaluation is ongoing.

OP-044

ORAL PRESENTATION - INTRACRANIAL PITUITARY/PARASELLAR
03-06-2026 12:30 - 13:30

THE ROLE OF STEREOTACTIC RADIOSURGERY AND HYPOFRACTIONATED RADIOTHERAPY IN THE MANAGEMENT OF PITUITARY ADENOMAS WITH CAVERNOUS SINUS INVASION: A SINGLE-CENTER EXPERIENCE SINCE 2005

Andrey Golanov, Denis Semenov, Ivan Osinov, Alexander Savateev, Valeriy Kostyuchenko, Sergey Banov, Irina Yurikova, Evgeniya Novikova
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Introduction: Pituitary adenomas (PA) invading the cavernous sinus (CS) present a complex clinical challenge. Stereotactic radiosurgery (SRS) and hypofractionated radiotherapy (HFRT) are key modalities for achieving tumor growth control and managing endocrine function.

Materials and Methods: A retrospective analysis of 238 patients with PA treated between 2005 and present. A subgroup of 45 patients (18.9%) with CS invasion (M:F=15:30) underwent 46 procedures (39 SRS, 7 HFRT). Treatment platforms included CyberKnife/PFX (2005-2018) and the Gamma-Knife ICON system (2018-present). Outcomes assessed were tumor control, endocrine response, and toxicity.

Results: With a median follow-up of 52 months (range 12-145), the overall tumor control rate for PAs with CS invasion was 93.3%, consistent with literature reports of 88-97%. For the 31 hormonally inactive adenomas, the control rate was 96.8%. Among the 14 hormonally active tumors, biochemical remission (normalization or significant reduction of hormone levels) was achieved in 57.1%, including 5 of 8 somatotropinomas and 2 of 4 prolactinomas. The adverse event profile was favorable. The rate of new, permanent anterior pituitary hormone deficiency was 8.9%. Transient morbidity included headache in 4 patients (8.9%). No radiation-induced optic neuropathy or other high-grade (≥3) toxicities were observed, supporting the excellent safety profile of modern precision radiotherapy.

Conclusions: SRS and HFRT provide high rates of tumor control (93.3%) and acceptable endocrine remission (57.1%) for complex PAs with CS invasion, with a low rate of serious complications. The strategic flexibility offered by modern platforms like Gamma-knife and CyberKnife platforms allow for the safe application of both SRS and HFRT, validating their role as effective treatments for this challenging pathology.

OP-045

ORAL PRESENTATION - INTRACRANIAL PITUITARY/PARASELLAR
03-06-2026 12:30 - 13:30

A COMPARATIVE CARBON FOOTPRINT ANALYSIS OF GAMMA KNIFE RADIOSURGERY AND SURGICAL RESECTION IN A CASE OF INTRACRANIAL MENINGIOMA

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Introduction The healthcare industry accounts for approximately 4–5% of global carbon emissions, with operating rooms, intensive care units (ICUs), and diagnostic imaging contributing disproportionately to this footprint. As climate-conscious medicine gains momentum, quantifying the environmental impact of treatment modalities has emerged as a critical area of focus, particularly within resource-intensive specialties such as neurosurgery.

Objective To compare the carbon footprint (CFp) of Gamma Knife radiosurgery (GKRS) versus open surgical resection for intracranial meningiomas, utilizing literature-based estimates for energy consumption, hospital infrastructure, waste generation, and postoperative care.

Methods
A carbon accounting model was developed using peer-reviewed data for a standard 30-minute GKRS procedure and a 4-hour surgical resection. Model inputs included electricity consumption, transportation (patient and staff), single-use waste, sterilization, and energy-intensive equipment (magnetic resonance imaging, computerized tomography, Gamma Knife). Postoperative hospitalization emissions were calculated based on literature median lengths of stay for the ICU (1.92 days) and neurosurgical ward (2.08 days). Emissions were quantified in kilograms of CO_2 equivalent ($kgCO_2$).

Results
The total CFp of GKRS was estimated at 42.1 $kgCO_2$, whereas surgical resection produced a substantially higher CFp of 429.2 $kgCO_2$. This nearly 10-fold difference was primarily driven by the absence of postoperative hospitalization for GKRS. In contrast to the carbon-intensive ICU (264.96 $kgCO_2$) and ward stays (93.6 $kgCO_2$) required for surgery, which collectively accounted for over 80% of the surgical footprint.

Conclusion
Although both treatment modalities offer comparable clinical outcomes in small, well-selected tumors, GKRS is associated with a nearly 10-fold reduction in CFp compared to surgery. Integrating sustainability metrics into treatment algorithms for benign conditions represents a critical step toward more environmentally responsible neurosurgical care.

OP-046

ORAL PRESENTATION - INTRACRANIAL PITUITARY/PARASELLAR
03-06-2026 12:30 - 13:30

DOSIMETRIC COMPARISON OF HYPERARC VERSUS COPLANAR VMAT IN FRACTIONATED STEREOTACTIC RADIOTHERAPY FOR PITUITARY ADENOMAS

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Background Radiotherapy for pituitary adenomas requires balancing target coverage with organs sparing. Coplanar volumetric modulated arc therapy (VMAT) is standard. HyperArc (HA) automates non-coplanar trajectory optimization, improving conformality and gradient fall-off. This study aims to quantify HA's dosimetric advantages over 2-arc coplanar VMAT for fractionated stereotactic pituitary adenoma treatment.
Methods Adult patients in BC Cancer Victoria, previously treated with 2-arc coplanar VMAT (50.4 Gy/28 fractions), were retrospectively (re-)planned using Eclipse AAA 18 algorithm, generating three plans per patient: 2-arc coplanar VMAT (2-Arc), HA optimization with Manual Normal Tissue Objective (NTO) (HA-Manual), and HA with automated SRS NTO (HASRS). All plans used identical contours and constraints. Primary endpoints: PTV D98%, conformity index, optic chiasm Dmax. Secondary endpoints assessed other PTV parameters; and doses to organ at risks. Statistical analysis employed Friedman test with Bonferronicorrected post-hoc Wilcoxon signed-rank tests; ANOVA sensitivity testing was applied to primary endpoints.
Results Ten patients were included. HA-SRS significantly improved target coverage, increasing median PTV D98% by 1.7 Gy versus 2-Arc ($p=0.002$) and by 0.6 Gy versus HAManual ($p=0.002$). Conformity was significantly higher with the two HA NTOs than 2-Arc ($p=0.002$). While optic chiasm Dmax remained similar, HA-SRS reduced ocular exposure: median retinal and anterior chamber Dmax decreased by around 50% (around 5 Gy absolute reduction each; $p=0.002$), and temporal lobe mean dose decreased by 1.8 Gy ($p=0.002$). HA slightly increased normal brain mean dose (+0.6 Gy; $p=0.004$) and monitor units (+7%)
Conclusions HAs significantly improved target coverage and conformity while reducing doses to retinae, anterior chambers, and temporal lobes versus 2-Arc. HA-SRS provides optimal dosimetric balance, potentially minimizing long-term ocular toxicity. However, the magnitude of the improvements, particularly in OAR sparing, may be small and must be weighed against the longer treatment times. Larger prospective studies are warranted to establish clinical benefit justifying routine implementation

OP-047

ORAL PRESENTATION - EXTRACRANIAL GU
03-06-2026 12:30 - 13:30

A RADIOMIC MACHINE LEARNING MODEL TO PREDICT PROSTATE CANCER RESPONSE TO CYBERKNIFE TREATMENT.

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Objective We developed a machine learning model based on T1 MRI pre-treatment radiomics and clinical data to predict the risk of prostate cancer patient to not respond to Cyberknife treatment within 36 months and support medical decision.

Material and Methods From a retrospective series of consecutive clinically localized prostate cancer (PC) patients treated from 2015 to 2023 we analyzed 119 patients (45 low risk, 49 medium risk and 25 high risk according to D'Amico risk classification) with at least 36 months of follow-up: 18 with recurrence (not-responding) and 101 under biochemical control (responding). All the patients were treated with Cyberknife and two schedules were administred: 38 Gy in 4 fractions of 9.5 Gy and 37.5 Gy in 5 fractions of 7.5 Gy (some patients received a concomitant boost to the dominant nodule for a total dose of 50 Gy in 5 fractions). We collected PC pre-treatment MR T1-weighted images, risk class, stage and PSA values (% difference before and after 6 months from treatment). Such dataset was used for training and cross-validation of ensembles of machine learning algorithms supervised during learning by 36 months follow-up as a reference standard.

Results An ensemble of support vector machines (SVM) showed a sensitivity of 74% in identifying subjects not responding and a specificity of 71% in identifying subjects with low risk of recurrence (training set of 34 patients treated in 2015-2017, 25 responding, 9 not responding). When externally tested on an independent set of 85 patients treated in 2018-2023, the SVM ensemble correctly classified all 9 patients with recurrence (sensitivity 100%) and 63 of 76 patients under biochemical control (specificity 83%).

Conclusion Our radiomic model shows high potential to support medical decision-making towards long-interval versus short-interval follow-up or treatment changing of PC treated by CyberKnife. Subsequent studies are ongoing to consolidate these results.

OP-048

ORAL PRESENTATION - EXTRACRANIAL GU
03-06-2026 12:30 - 13:30

PROSTATE STEREOTACTIC BODY RADIOTHERAPY WITH A MRI DEFINED FOCAL SIMULTANEOUS INTEGRATED BOOST TO THE DOMINANT INTRAPROSTATIC NODULE: TOXICITY PROFILE AND CLINICAL OUTCOMES

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Objectives: Stereotactic body radiotherapy (SBRT) represents an effective curative option for localized prostate cancer (PC). The aim of this study is to assess toxicity, quality of life (QoL) outcomes, and biochemical recurrence rates after SBRT with simultaneous integrated boost (SIB) to the dominant intraprostatic nodule (DIN) defined on MRI.

Patients and Methods: Between May 2020 and July 2024, 68 patients with localized PC, with a mean iPSA of 9.04 ng/ml (range 2.7 – 44.7) underwent Cyberknife SBRT. 42 (62%) patients had intermediate and 13 (19%) high risk disease. All patients received 37.5 Gy in 5 consecutive fractions to the whole prostate gland, having an average volume of 67 cm^3 (range 31 – 138), a SIB up to a total dose of 50 Gy was applied to the DIN having an average volume of 1.47 cm^3 (range 0.16-5.40). 6 patients (4 high risk and 2 intermediate risk) received HRT for mean 12 months (range 6-36). Real time intrafraction motion tracking was used.

Results: With a mean FUP of 26 months (range 6 – 54) mean PSA was 0,92 ng/ml (range 0.01 – 9.75). Biochemical failure was observed in 6 patients (3 high and 3 intermediate risk diseases): 2 high and 1 intermediate risk patients were retreated for locale failure after mean 36 months with biochemical control. No acute or late GI ≥ G2 toxicity was observed. Only 2 patients (3%) suffered G2 GU acute toxicity and only one G3 GU acute toxicity. No GU late toxicity ≥ G3 was observed. The patient-reported QoL metrics at the time of last FUP were not significantly different than the baseline.

Conclusions: SIB to the DIN was well tolerated with similar acute toxicity rates compared with historical prostate SBRT cohorts. Longer follow-up is required to confirm long term results, both for tumor control and late toxicity.

OP-049

ORAL PRESENTATION - EXTRACRANIAL GU
03-06-2026 12:30 - 13:30

STEREOTACTIC BODY RADIOTHERAPY WITH 42.7 GY IN 7 FRACTION FOR LOCALIZED PROSTATE CANCER: REAL WORLD CLINICAL EXPERIENCE

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Background: Stereotactic body radiotherapy (SBRT) is increasingly used as a standard treatment for localized prostate cancer. The Hypo-PC-RT trial recently reported excellent long-term outcomes with a fractionation schedule of 42.7Gy/7 fractions, though this regimen is less commonly applied in routine practice. We analyzed outcomes from a large cohort treated with this fractionation at our institution.

Methods: Patients with localized prostate cancer were treated with 42.7Gy/7 fractions, following the Hypo-PC-RT protocol. Androgen deprivation therapy (ADT) was administered at the treating physician's discretion. Standardized bladder filling and rectal preparation protocols were applied. Treatments were delivered on a C-arm linear accelerator with strict image-guided radiotherapy on alternating days. Use of a rectal balloon was encouraged but not mandatory. Toxicity and oncologic outcomes, including progression-free survival (PFS) and overall survival (OS), were retrospectively collected.

Results: A total of 109 patients received SBRT; 76 had available follow-up data. Median age was 73 years (range 54–88). The most common NCCN risk-group was unfavorable intermediate risk (40.8%), and the most frequent clinical T-stage was cT2c (31.6%). Median PSA was 7.6 ng/ml. ADT was given in 17.1%, mainly short-term (69.2%). Prior TUR-P was documented in 6.6%. A rectal balloon was used in 77.6%; no fiducials were placed. Median follow-up was 14 months (range 1-55). Rates of acute grade 2 genitourinary (GU) and gastrointestinal (GI) toxicity were 25% and 13.2%, respectively; late grade 2 toxicity rates were 7.9% (GU) and 9.2% (GI). There was no G3. Two patients experienced grade 4 GI toxicity, one with prior TUR-P. Two treatment failures were recorded, resulting in a 1-year PFS of 95.4%. Four patients died, one due to prostate cancer. The 1-year OS was 95.4%.

Conclusion: In this real-world cohort, SBRT with 42.7Gy/7 fractions was well tolerated and showed excellent early oncologic outcomes. Longer follow-up is needed to confirm these results.

OP-050

ORAL PRESENTATION - EXTRACRANIAL GU
03-06-2026 12:30 - 13:30

FIRST ARGENTINIAN EXPERIENCE WITH STEREOTACTIC BODY RADIOTHERAPY (SBRT) FOR OLIGOMETASTATIC GYNECOLOGICAL CANCER

Lucas Caussa, Ariel Gomez Palacios, Mariano Salum, Ana Raies, Diego Fernandez, Belen Raiden, Luciana Brun, Jose Gilardi, Ofelia Perez Conci, Franco Maciel, Carol Rios, Julieta Abate Daga, Camila Vargas, Fernando Martini, Ivan Charif Coll, Egle Aone, Edgard Falco, Edgardo Garrigo, Maria Diaz Vazquez, Gustavo Ferraris
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Background:
Stereotactic body radiotherapy (SBRT) is increasingly used to manage oligometastatic disease, offering high local control with limited toxicity. However, evidence specific to oligometastatic gynecological cancer remains scarce. This study reports the first Argentinian institutional experience evaluating clinical outcomes of SBRT in patients with oligometastatic endometrial or cervical cancer.

Methods:
A retrospective review included patients with endometrial or cervical cancer treated with SBRT for oligometastatic lesions between 2017 and 2023. Clinical data, imaging, and treatment parameters were analyzed. Tumor response was assessed using RECIST criteria, while overall survival (OS), metastasis-free survival (MFS), and local control (LC) were estimated using the Kaplan–Meier method. Toxicities were graded according to CTCAE v5.0. SBRT regimens ranged from 25–50 Gy delivered in three to five fractions.

Results:
Twenty-two patients with 43 metastatic lesions were evaluated. Median age was 57 years, and median follow-up was 32 months. Primary tumors included endometrial (55%) and cervical (45%) cancer. The most frequently treated metastatic sites were lymph nodes (55%), lung (23%), pelvis (13%), and bone (9%). The mean delivered biologically effective dose was 70 Gy. One-year OS was 100%, and three-year OS was 60%, with a mean survival of 40.6 months. LC at three years reached 95%, and mean MFS was 22.3 months. The median interval before initiating subsequent systemic therapy was 10 months. Grade 1–2 acute toxicities occurred in 15% of patients, predominantly gastrointestinal symptoms and asthenia, with no grade ≥3 events.

Conclusion:
This study demonstrates that SBRT is a safe and effective option for selected patients with oligometastatic gynecological cancer. High local control rates, encouraging survival outcomes, and postponement of systemic treatment support the role of SBRT as a valuable consolidative strategy.

OP-051

ORAL PRESENTATION - EXTRACRANIAL GU
03-06-2026 12:30 - 13:30

FROGG CONSENSUS CLINICAL PRACTICE GUIDELINE ON STEREOTACTIC ABLATIVE BODY RADIOTHERAPY FOR PROSTATE CANCER

Therese Kang[1,2,3], Shreya Armstrong[4], Sarat Chander[5,6], Jeremy De Leon[7], Renee Finnigan[8], Suki Gill[9,10], Mario Guerrieri[11], Amy Hayden[12,13], Braden Higgs[14,15], Tanya Holt[16,17], Michael Jones[18,19], Yuan-Hong Lin[5], Giuseppe Sasso[20,21,22], Neetu Tejani[5,6], Vedang Murthy[23], Andrew Loblaw[24,25], Wee Loon Ong[1,2,3]

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Purpose: Stereotactic ablative body radiotherapy (SABR) is now an established treatment option for localised prostate cancer, supported by evidence from randomised clinical trials. However, there are variations in practice in terms of patient selection, treatment planning, and delivery. An initial survey among Australian and New Zealand radiation oncologists identified key areas of variations and uncertainties.

Methods: The Royal Australia and New Zealand College of Radiologists Faculty of Radiation Oncology Genitourinary Group (FROGG) developed a bi-national guideline to provide practical recommendations for the implementation and use of prostate SABR in Australia and New Zealand. Draft recommendations on several key questions (KQs) were developed by a multidisciplinary FROGG working party, refined through input from international experts. Using a modified Delphi process, KQs

were discussed, revised, and voted upon at the 2025 FROGG workshop. Recommendations for each KQs were reviewed and graded according to the Oxford Centre for Evidence-Based Medicine (OCEBM) framework.

Results: The guideline provides evidence-based and expert-consensus recommendations across several KQs in prostate SABR. KQ1 addresses patient selection for prostate SABR, including NCCN risk groups, baseline urinary symptoms, history of previous trans-urethral resection of the prostate, prostate volume, and hip prosthesis. KQ2 addresses planning preparation prior to prostate SABR, including the use of prostate magnetic resonance imaging, fiducial markers and rectal spacers. KQ3 addresses prostate SABR dose, fractionation, and schedule (including focal boost for intraprostatic lesions). KQ4 addresses the contouring of target volume (including intraprostatic lesions) and organs at risk (including urethra), and dose constraints. KQ5 addresses the technical aspects of prostate SABR treatment delivery, including intra-fraction motion management.

Conclusion: We present the FROGG bi-national evidence-based consensus guideline to inform best practice in safe delivery of prostate SABR in routine clinical practice. At the same time, there are areas of practice without robust evidence where further prospective research is required.

OP-052

ORAL PRESENTATION - EXTRACRANIAL ABDO
03-06-2026 12:30 - 13:30

DAILY ADAPTATION OF ABDOMINAL SBRT PLANS USING C-ARM LINAC HIGH PERFORMANCE CBCT

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Purpose: The proximity of gastrointestinal structures during abdominal stereotactic body radiotherapy (SBRT) increases the risk of high-grade toxicity and limits dose escalation due to inter- and intrafractional motion. Daily adaptive radiotherapy solutions are typically restricted to specialized systems such as MR-Linac or Ethos. This study aimed to develop and evaluate a workflow integrating HyperSight™ (HS) cone-beam CT (CBCT) with plan adaptation in RayStation, enabling efficient daily adaptation on a standard, nonadaptive C-arm linear accelerator.

Methods: The adaptive workflow used pretreatment HS-CBCT to automatically generate organ-at-risk (OAR) contours using AI and perform rigid image registration, followed by physician review, for delivered dose estimation. Deformable registration was used to create an adapted plan, which was iteratively optimized in RayStation. End-to-end testing was performed using three anatomically distinct pelvis phantoms. Dosimetric endpoints included GTV D90, PTV D95, and OAR maximum doses. A retrospective evaluation of four abdominal SBRT cases (12 fractions) compared delivered and adapted plans with respect to target coverage, OAR sparing, and monitor unit (MU) usage.

Results: The adaptation process requires approximately 10 minutes per fraction. Across all cases, adapted plans demonstrated improved or maintained dosimetric quality relative to delivered plans ($p<0.05$). GTV D90 and PTV D95 were consistently higher in adapted plans. In Patient 3, GTV D90 improved from 84.3% to 92.2% and PTV D95 from 86.3% to 92.1%. In Patient 4, GTV D90 increased from 90.7% to 97.6% and PTV D95 from 91.3% to 98.6%. Doses to OARs, including the small bowel and ipsilateral kidney, were reduced or maintained. MU usage was slightly reduced, indicating no increase in treatment complexity.

Conclusions: Integrating HS-CBCT with RayStation's streamlined plan adaptation provides dosimetric advantages for abdominal SBRT. It improves target coverage and OAR sparing without increasing treatment complexity and represents a practical alternative to Ethos or MR-Linac systems without the need for specialized delivery platforms.

OP-053

ORAL PRESENTATION - EXTRACRANIAL ABDO
03-06-2026 12:30 - 13:30

INTERFRACTION VOLUMETRIC CHANGES OF PATIENTS TREATED WITH LIVER STEREOTACTIC BODY RADIATION THERAPY USING MRI-GUIDED ADAPTIVE PLANNING

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Purpose/Objectives: MRI-guided linear accelerators (MRI-LINAC) allow for increased treatment precision. Visualization of interfraction changes on the MRI-LINAC can help inform PTV margins.

Materials/Methods: We retrospectively assessed patients within our health system receiving MRI-LINAC liver SBRT using daily eovist injections, real-time intrafraction MRI imaging, respiratory gating, and a uniform 3 mm GTV to PTV expansion. Adaptive planning was performed daily if tumor coverage or critical structure goals were not met. All plans met institutional dose constraints for SBRT. We evaluated mean volumetric changes in GTV contoured from the original plan through their treatment courses using dependent samples t-tests.

Results: We identified 30 liver patients with 36 unique liver lesions treated on the MRI-LINAC to a mode dose of 50 Gy in 5 fractions [range 35-55], with 19 HCC patients (22 lesions) and 11 metastatic patients (14 lesions). Baseline mean GTV volumes were 40.3 cc (range 1.2-295.5). 78% of fractions used adapted plans, with an 8.4% ± 14.35 SD mean change in volume over all fractions, $p<0.0015$ (95% CI of 3.55-13.26). GTV volumes in HCC patients increased by 6.39% ± 10.21, $p<0.008$ (95% CI of 1.86-10.92), while GTV volumes in metastatic patients increased by 11.56% ± 19.18, $p=0.04$ (95% CI of 0.49-22.64). GTV swelling and setup variation were generally compensated by the planned PTV expansion, with only 22 of 180 target fractions having appreciable GTV (>5%) outside initial PTV volumes upon recontouring if motion were no object.

Conclusions: The present study reports significant volume changes during adaptive SBRT on the 0.35T MR-LINAC. We observed appreciable swelling or shrinkage (>2%) in 56% and 11% of targets respectively. While smaller PTV margins are appropriate for patients treated on the MRI-LINAC due to the superior tumor delineation and dynamic tumor tracking, tumor swelling may necessitate larger volumes for SBRT on traditional linear accelerators.

OP-054

ORAL PRESENTATION - EXTRACRANIAL ABDO
03-06-2026 12:30 - 13:30

4D ROBUST OPTIMIZATION FOR LIVER SBRT IN CYBERKNIFE

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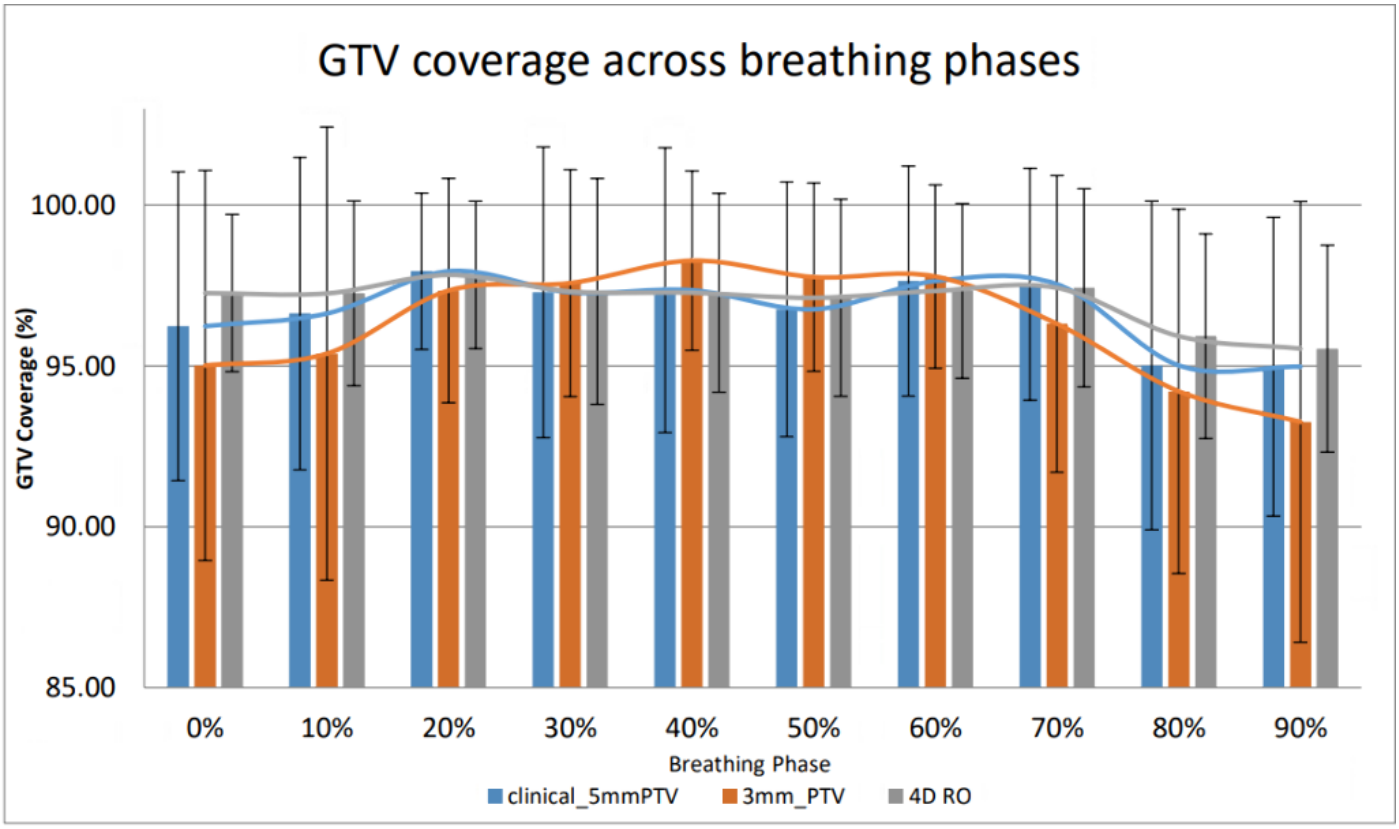
Introduction:
Respiratory motion and anatomical deformation present ongoing challenges in CyberKnife liver stereotactic body radiotherapy (SBRT). Conventional planning using population-based PTV margins may inadequately capture motion-related uncertainties, potentially compromising target coverage or increasing normal-liver dose. This study introduces a novel 4D robust optimisation (4DRO) workflow in RayStation, integrating deformable image registration (DIR) and 4D dose accumulation to enhance motion robustness and organ-at-risk (OAR) sparing in liver SBRT.

Methods:
Seven liver SBRT patients previously treated with fiducial-based Synchrony tracking were retrospectively analysed. Ten-phase 4DCT datasets were imported into RayStation 2024B, with fiducial-guided rigid registration and DIR used to propagate target and OAR contours. Three planning strategies were evaluated: (1) clinical PTV with a 5mm margin, (2) reduced-margin 3mm PTV, and (3) 4DRO incorporating the planning CT and two deformation-extreme phases (0% and 40%) with a 3mm systematic uncertainty. All plans were recalculated across ten respiratory phases, and doses were accumulated to generate composite 4D dose distributions. A 3mm setup uncertainty was also applied for robustness evaluation. Friedman and Wilcoxon tests assessed differences in GTV coverage, mean liver dose (MLD), and robustness under simulated isocentre shifts.

Results:
All approaches achieved acceptable target coverage; however, 4DRO consistently produced the lowest MLD and the smallest phase-dependent variability. Although the 3mm PTV plan reduced MLD relative to the clinical plan, it exhibited the greatest inter-phase variation, with minimum GTV coverage dropping to 92.2%. In contrast, 4DRO maintained >95% coverage across all phases and demonstrated superior worst-case robustness, achieving the highest GTV D_{min} and coverage under 3mm shifts. Phase-dependent MLD fluctuations were also lowest with 4DRO.

Conclusion:
This 4DRO workflow improves plan robustness and reduces MLD while maintaining stable target coverage across respiratory phases. By explicitly modelling deformation and uncertainty, 4DRO offers a practical and clinically advantageous alternative to empirical PTV-margin approaches for CyberKnife liver

SBRT.


GTV coverage across breathing phases
GTV Coverage (%)
100.00
95.00
90.00
85.00
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Breathing Phase
clinical_5mmPTV
3mm_PTV
4D RO

OP-055

ORAL PRESENTATION - EXTRACRANIAL ABDO
03-06-2026 12:30 - 13:30

INSTITUTIONAL EXPERIENCE WITH SBRT REIRRADIATION FOR LOCALLY RECURRENT RECTAL CANCER

Lucas Caussa, Belen Raiden, Ariel Gomez Palacios, Ofelia Perez Conci, Ana Raies, Jose Gilardi, Franco Maciel, Carol Rios, Mariano Salum, Julieta Abate Daga, Camila Vargas, Fernando Martini, Ivan Charif Coll, Edgard Falco, Egle Aone, Caroline Descamps, Edgardo Garrigo, Luciana Brun, Diego Fernandez, Maria Diaz Vazquez, Gustavo Ferraris
CENTRO DE RADIOTERAPIA DEAN FUNES, Radioterapia, CORDOBA, Argentina

Background:
Locally recurrent rectal cancer (LRRC) remains an oncologic challenge, particularly in patients previously treated with pelvic radiation. SBRT-Reirradiation(SBRT-ReRT) has emerged as a therapeutic alternative aimed at achieving local disease control, improving symptoms and quality of life. This study evaluates the efficacy and safety of SBRT-ReRT in patients with LRRC, analyzing local control(LC), overall survival(OS), progression-free survival(PFS), and treatment tolerance.

Methods:
A retrospective review of patients with LRRC treated at the Deán Funes Radiotherapy Center (Córdoba, Argentina) between 2017 and 2024. Twenty previously irradiated patients were included; seventeen(85%) had received 50 Gy/25 fractions and three(15%) had received 25 Gy/5 fractions. Initial staging of 42% were IIIB and 25% II. SBRT-ReRT was delivered with 25–40 Gy/5 fractions using linear accelerator. The mean interval between radiation courses was 30 months (range 4–101). Statistical analysis included Kaplan–Meier estimation for OS and Kruskal–Wallis testing for survival comparisons, with significance set at p=0.05.

Results:
A mean age of 70 years (range 37–88) and median follow-up of 19 months (range 2–94). Mean PFS was 18 months and OS was 14 months. LC was achieved in 55% of patients, with a mean PFS of 37 months, whereas patients with progression had a mean PFS of 7 months. Among survivors, OS was 26 months, compared with 7 months in deceased patients. Seventy percent experienced recurrence between 1 and 5 years after initial radiation. OS strongly correlated with time to recurrence: 94 months for late recurrence (>5 years), 12 months for intermediate (1–5 years), and 1 month for early (<1 year; p=0.046). Toxicity occurred in five patients, including two grade 3–4 events.

Conclusion:
SBRT-Reirradiation represents a feasible therapeutic option in LRRC, offering acceptable LC, OS, and tolerability in unresectable patients. Time to recurrence emerged as the strongest predictor of survival, underscoring the importance of careful multidisciplinary patient selection.

OP-056

ORAL PRESENTATION - EXTRACRANIAL THORACIC
03-06-2026 16:15 - 17:15

REDUCED PLANNING TARGET VOLUME MARGINS IN CENTRAL LUNG STEREOTACTIC BODY RADIATION THERAPY WITH CYBERKNIFE FIDUCIAL TRACKING

Ashlesha Gill[1], Nicholas Bucknell[2], Gordon Anderson[2], Colin Tang[2], Mahsheed Sabet[2], Adriano Polpo[1], Milad Mirzaei[2], Pejman Rowshan Farzad[1]
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Background: Stereotactic body radiation therapy (SBRT) for central lung tumours presents challenges given the high risks of toxicity. Real-time tumour tracking provides continuous intrafraction target localisation and motion compensation during beam delivery, enabling smaller margins. In CyberKnife lung fiducial tracking, a 5-mm planning target volume (PTV) margin is the standard protocol for lung tumours, irrespective of the tumour location. The study reviewed restrospective CyberKnife lung fiducial tracking data to assess whether the optimal margins varied between the peripheral, central and ultra-central lung locations.

Materials and methods: 122 patients treated with CyberKnife lung fiducial tracking were selected for the study (91 peripheral, 22 ultra-central, and 9 central). The margins were calculated based on the van Herk framework. For this, the correlation error and the prediction error corresponding to the CyberKnife Synchrony model were quantified from the log files. Only the fraction timepoints where the Synchrony model was full built were considered as they represent routine tracking during radiation delivery. Targeting error was quantified from end-to-end tests. Deformation error was quantified based on the specific tumour motion range of the patient. Segmentation error was referenced from a previous study (Jung et al. 2015 DOI: http://dx.doi.org/10.1016/j.ijrobp.2015.02.055).

Results: An isotropic 3-mm PTV margin was adequate for central and ultra-central lung tumours, whereas an isotropic 5-mm margin remained appropriate for peripheral lung tumours.

Conclusions: These findings support a location-adapted margin strategy for lung SBRT with CyberKnife fiducial tracking. PTV margin for central and ultra-central lung tumours can be reduced to an 3-mm, with the potential to reduce dose to adjacent critical structures while maintaining target dose coverage.

OP-057

ORAL PRESENTATION - EXTRACRANIAL THORACIC
03-06-2026 16:15 - 17:15

SPARE: SEGMENT-TARGETED PRECISION ABLATIVE RADIOTHERAPY TO CONTROL RADIATION PNEUMONITIS BY LIMITING LOW-DOSE EXPOSURE TO INVOLVED PULMONARY SEGMENTS

Shinya Neri[1], Masashi Nozue[1], Katsumasa Nakamura[2]
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Background: Radiation pneumonitis (RP) is a major dose-limiting toxicity after lung SBRT. RP frequently develops in anatomically normal lung regions exposed to low radiation doses, suggesting that where radiation is delivered may be as important as how much is delivered.

Purpose: We introduce SPARE (Segment-targeted Precision Ablative Radiotherapy with Exact delivery), a novel anatomy-driven SBRT planning strategy that confines both high-dose and low-dose radiation to the tumor-bearing pulmonary segment or subsegment, thereby controlling the anatomical location and extent of RP. Methods: We analyzed four lung SBRT cases treated at our institution. In Cases 1-2, conventional planning resulted in low-dose spillage into anatomically uninvolved segments, with subsequent Grade 1 RP developing outside the tumor-bearing segment. This anatomical discordance prompted development of the SPARE approach. In Cases 3-4, we prospectively applied SPARE planning, using precise segmental/subsegmental anatomy to restrict both prescription dose and low-dose regions to the involved lung segment, while minimizing dose to adjacent normal segments.

Results: In SPARE-planned cases (Cases 3-4), RP was anatomically confined to the targeted segment/subsegment, with preservation of uninvolved lung regions. In contrast, conventional plans (Cases 1-2) resulted in RP extending into anatomically normal segments corresponding to low-dose spillage areas.

Conclusion: SPARE represents a paradigm shift in lung SBRT planning by prioritizing anatomical preservation of uninvolved pulmonary segments. This approach is supported by surgical data (JCOG0802 trial) demonstrating that segmentectomy yields superior overall survival compared to lobectomy in early-stage lung cancer, despite slightly higher local recurrence—suggesting that functional lung preservation in vital organs may translate to survival benefit. By controlling RP location through anatomy-guided dose confinement, SPARE may reduce functional lung loss and improve clinical outcomes. This concept is applicable to other segmentally organized organs including liver and kidney.

OP-058
ORAL PRESENTATION - EXTRACRANIAL THORACIC
03-06-2026 16:15 - 17:15

MARKERLESS BREATH-HOLD SBRT FOR LUNG LESIONS USING STEREOSCOPIC X-RAYS AND ANATOMICAL CORRELATION OBJECTS: A PROSPECTIVE FEASIBILITY STUDY

Thierry Gevaert, Marlies Boussaer, Cristina Teixeira, Anette Bretz, Selma Ben Mustapha, Anne-Sophie Bom, Sven Van Laere, Mark De Ridder
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Introduction Stereotactic body radiotherapy (SBRT) offers strong local control for lung lesions but remains limited by respiratory motion. Markerless deep inspiration breath-hold (DIBH) using ExacTrac Dynamic, which integrates thermal surface imaging with stereoscopic x-rays, provides real-time motion management. This study presents the first clinical use of Correlation Objects, anatomical surrogates derived from 4DCT, for markerless lesion localization during DIBH-SBRT.

Materials and Methods Twenty-four patients (26 lesions) underwent simulation with both 4DCT and DIBH-CT for target definition and motion characterization. Anatomical surrogates were generated using a dedicated Brainlab software solution to create Correlation Objects, bronchiolar branches exhibiting motion similarity with the lesion, derived from 4DCT and converted into DRRs for stereoscopic x-ray registration. For each lesion, three Correlation Objects of varying motion similarity and size were created and evaluated. SGRT-based prepositioning and stereoscopic x-ray positioning were compared with gated CBCT to assess feasibility, workflow integration, DIBH reproducibility, and geometric accuracy.

Results All 123 fractions across 24 patients were completed successfully under DIBH without complications, with all patients able to perform multiple reproducible breath-holds. DIBH reduced the mean lesion volume from 5.5 cc to 3.4 cc (54% reduction). Inter- and intra-breath-hold stability averaged 1.9 ± 0.7 mm. Residual setup errors using stereoscopic x-rays with Correlation Objects, verified by gated CBCT—were 2.8 ± 4.9 mm (vertical), 3.1 ± 4.5 mm (longitudinal), and 2.9 ± 3.4 mm (lateral), yielding a mean 3D vector of 4.1 ± 5.9 mm. No significant differences were observed between different Correlation Objects, indicating that within the defined motion similarity threshold, surrogate selection does not affect geometric targeting.

Conclusion This first-in-patient experience demonstrates the technical and clinical feasibility of fully markerless DIBH-SBRT using stereoscopic x-rays (ExacTrac Dynamic) with Correlation Objects. The workflow was accurate, reproducible, and well-tolerated, supporting broader clinical implementation.

OP-059

ORAL PRESENTATION - EXTRACRANIAL THORACIC
03-06-2026 16:15 - 17:15

EXPANDING THE THERAPEUTIC WINDOW IN LUNG SBRT: THE ROLE OF RESPIRATORY MOTION MANAGEMENT

Thierry Gevaert[1], Marlies Boussaer[1], Alexander V Louie[2], Rupesh Kotecha[3], Sven Van Laere[1], Arjun Sahgal[2], Mark De Ridder[1]
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Introduction: Respiratory motion-management is widely implemented in lung stereotactic body radiotherapy (SBRT) to reduce geometric uncertainties, but its independent impact on clinical outcomes is unclear. This systematic review examined whether motion management improves local control or toxicity, expands SBRT eligibility, and whether clinically relevant motion thresholds exist.

Material and methods: Databases were searched using MeSH terms and keywords related to SBRT, respiratory motion management, and lung malignancies. Of 587 screened abstracts, 88 full-text clinical, technical, and physics-based studies were included. Evaluated strategies were ITV-based approaches, respiratory gating, real-time tumor tracking, breath-hold techniques, abdominal compression, and MR-guided adaptive workflows.

Results Direct evidence attributing improved local control or reduced toxicity to motion-management was limited. Comparative clinical studies demonstrated no significant differences in oncologic outcomes between advanced motion-management techniques and standard ITV-approach, while abdominal compression was consistently associated with inferior local control, likely due to poor reproducibility. In contrast, consistent evidence indicated that advanced motion-management expands eligibility for lung SBRT by enabling safe treatment of patients with large respiratory motion, (ultra)-central tumors, small or poorly visible lesions, significant pulmonary comorbidity, or when treatment intensification is practiced. Threshold analysis revealed no universal cutoff, however, motion amplitudes of approximately 5 mm frequently triggered gating in clinical practice, amplitudes around 10 mm represented a consistent dosimetric decision for adopting advanced motion-management. Across platforms, residual intrafraction motion was typically constrained to within 2-5 mm with gated or tracked delivery.

Conclusions Current evidence does not demonstrate that respiratory motion-management alone improves outcome in lung SBRT. Its principal value lies in expanding the therapeutic window by enabling safe treatment of patients with significant tumor motion or challenging anatomy. Motion thresholds should therefore be regarded as guiding ranges rather than universal criteria, reflecting distinct requirements for patient selection, delivery precision, and dosimetric robustness.

OP-060

ORAL PRESENTATION - GENERAL SBRT
03-06-2026 16:15 - 17:15

SABRVICAL: A RANDOMISED OPEN-LABEL PHASE II TRIAL TO ASSESS THE SAFETY AND EFFICACY OF STEREOTACTIC ABLATIVE BODY RADIOTHERAPY AS A BOOST AFTER CHEMORADIOTHERAPY FOR STAGE IB3-IIIC1 CERVICAL CARCINOMA.

Christian Haydee Flores-Balcázar[1,2], Lucely Cetina-Pérez[3], Julissa Luvián-Morales[3], Tatiana Galicia-Carmona[3], Elizabeth García-García[3], Silvia Alarcon-Barrios[3], Shuhey Matsumoto-Palomares[2], Diego Chávez-Saldívar[2], Adamary Marin-Trinidad[2], Francisco Gerardo Castro-Pérez[2], Elizabeth Trejo-Durán[3], Francisco Lozano-Ruiz[3], Víctor Monjaráz-Embriz[3], Javier Altamirano-García[2], Germán Chávez-Tahuilán[3], Oscar Arrieta-Rodríguez[3], José Sifuentes-Osornio[4]
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Background: In patients with locally advanced uterine cervix carcinoma, the treatment of choice is cisplatin-based concurrent chemoradiotherapy (40mg/m2 cisplatin with VMAT RT 45Gy/25FX) followed by an additional brachytherapy boost. However, brachytherapy administration is not always feasible due to patient-related comorbidities or logistical issues related to limited equipment availability. The present study aims to compare the safety and efficacy of stereotactic ablative radiotherapy as a cervical boost after concurrent chemoradiotherapy in patients with stage IB3–IIIC1 cervical cancer to that of patients treated with the standard brachytherapy arm.

Methods and Analysis: This is an ongoing randomised trial in patients with stage IB3–IIIC1 cervical cancer, randomly allocated to either stereotactic ablative radiotherapy or high-dose-rate 3D intracavitary brachytherapy after completion of chemoradiotherapy (Version 1.0 Identifier: NCT06560697). The primary endpoint is the frequency of toxic effects, specifically grade 3 or higher gastrointestinal, genitourinary, and hematologic toxicities, graded according to CTCAE V.5.0 criteria; the secondary endpoints are local control, recurrence, progression-free survival, overall survival, and quality of life.

Results: To date, 53 patients have been recruited: 32 in the SBRT arm and 21 in the brachytherapy boost arm. With a median follow-up of 12 months (RIQ 9-15), the 6-month local control is 100% for both techniques; the 12-month local control is 81% for the SBRT boost technique and 89.5% for the brachytherapy boost technique (Log-rank p= 0.570). 1-year recurrence-free survival is 90% for the SBRT arm vs 92% in the brachytherapy arm (log-rank p=0.875). 1-year Grade 3 GI toxicity probability is 1% in the brachytherapy arm vs 11% in the SBRT group, and 1-year Grade 3 GU toxicity probability is 2% vs 10 % in the Brachytherapy and SBRT boost arms, respectively.

Discussion: First randomised study of its kind, addressing the role of stereotactic ablative radiotherapy after chemoradiotherapy in locally advanced cervical carcinoma.

OP-061

ORAL PRESENTATION - GENERAL SBRT
03-06-2026 16:15 - 17:15

IMPROVING SBRT WITH RADIOPDT FOR BONE METASTASES

Deepak Dinakaran[1], Azin Mirzajavadkhan[2], Margarete Akens[3], Muhammad Rafiq[4], Brian Wilson[3], Cari Whyne[5]
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Bone metastases appear in up to 1/3 of all cancer patients, including prostate, breast, and lung cancers. These metastases cause pain and significantly increase adverse skeletal related events. Treatment with radiation, particularly with stereotactic body radiotherapy (SBRT), aims to reduce pain, improve skeletal stability, and locally control tumour growth. SBRT can provide excellent local control, but diminishes bone quality, leading to increased post-treatment fractures. Post-SBRT fractures are chronic, painful and significantly impact quality of life. Photodynamic therapy (PDT) has also been considered for local treatment of spinal metastases. Non-thermal light activated photosensitizers used in PDT have been shown preclinically to both destroy tumour cells in skeletal metastases and cause bone deposition, improving the biomechanical strength of bone. PDT's main limitations in treating bone metastases are challenges in light delivery and dosimetry. RadioPDT provides a promising solution by harnessing SBRT's precision X-ray delivery to activate photosensitizers for PDT. Our previous work developed a radioPDT system using $LaF_3:Ce^{3+}$ nanoscintillators co-encapsulated with a protoporphyrin photosensitizer (PPIX) within a PEG-PLGA nanocarrier that can achieve tumor ablation at sub-SBRT doses. Here, we present radioPDT applied to ACE-1 prostate cancer metastases in rat femoral bone. Luciferase tagged ACE-1 cells were injected intracardiac into 5-6 week old athymic male rats and treated ~10 days later. The bone metastases successfully took up nanoparticles as measured by mass spectrometry and microCT. We compared a single fraction 8Gy vs 8Gy+radioPDT to femoral metastases. BLI showed 60% reduction in tumor growth in radioPDT treated rats ($p=0.048$). RadioPDT also showed significant increase in bone mineral density vs SBRT alone. These results show radioPDT can magnify SBRT's effectiveness at treating bone metastases, while minimizing adverse events with lower radiation doses. Further studies aim to compare control rates against full-dose SBRT, and pathologic/biometric analysis of bone strength and quality.

OP-062

ORAL PRESENTATION - GENERAL SBRT
03-06-2026 16:15 - 17:15

A SYSTEMIC REVIEW OF OUTCOMES OF NON-SPINE BONE METASTASES TREATED WITH SINGLE VERSUS MULTI-SESSION STEREOTACTIC BODY RADIOTHERAPY

Joseph Cheng, Chia Cheng Lee, Shing Fung Lee, Timothy Cheo, Teng Hwee Tan, Balamurugan Vellayappan
National University Cancer Institute, Department Of Radiation Oncology, Singapore, Singapore

Introduction: Stereotactic body radiotherapy (SBRT) for non-spine bone metastases (NSBM) improves outcomes compared to conventional radiotherapy. Whether outcomes differ between single-session and multi-session SBRT remains unclear.

Methods: We systematically searched MEDLINE and EMBASE from inception to 14 July 2025. The primary outcome was 1-year local control; secondary outcomes were fracture rate and pain control. Quantitative synthesis used a random-effects model. Subgroup analyses explored potential effect modifiers (e.g., dose, lesion type). Risk of bias was assessed with ROBINS-I, and evidence certainty was graded using GRADE.

Results: Thirteen studies were included: 11 multi-session (1,318 sites) and 2 single-session (131 sites). The pooled 1-year local control rate was 88% (95% CI: 77.5–95.9%, I^2=88.2%) for multi-session and 100% (95% CI: 98.3–100%, I^2=0%) for single-session. The pooled fracture rate was 4.78% (95% CI: 0.77–11.26%, I^2=82.4%) for multi-session (7 studies) and 0.54% (95% CI: 0–22.68%, I^2=0%) for single-session. Pain control rates were 78.46% (95% CI: 76.33–80.53%, I^2=0%) for multi-session (3 studies) and 76.53% (95% CI: 0–100%, I^2=92.8%) for single-session. In multi-session studies, prescribed dose, lesion type (lytic vs. sclerotic), and location (weight-bearing vs. non-weight-bearing) did not significantly modify fracture or local control outcomes. Grade ≥2 toxicities were similar between groups.

Conclusion: Based on very low-certainty evidence, both single-and multi-session SBRT achieve high 1-year local control with low fracture rates, with pooled estimates favoring single-session therapy. Further studies directly comparing these approaches would help to decipher these findings better.

OP-063

ORAL PRESENTATION - GENERAL SBRT
03-06-2026 16:15 - 17:15

SBRT FRACTIONATION DRIVES ANTI-TUMOR IMMUNITY IN A PRECLINICAL NSCLC MODEL

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Purpose/Objective: SBRT is the standard of care for early-stage inoperable NSCLC. Yet, how different SBRT fractionation schedules remodel the tumor microenvironment and modulate subsequent response to immunotherapy remains poorly defined in preclinical models. This study aims to compare the immune effects of single versus multifraction SBRT in a NSCLC mouse model to identify potential synergy with immune checkpoint inhibitors and guide ongoing clinical studies.

Material/Methods: Mice bearing subcutaneous Lewis lung carcinoma tumors were irradiated using a small-animal image-guided radiation platform. Experimental groups received either 30Gy/1 fraction (SF-SBRT) or 48Gy/4 fractions (MF-SBRT), matching clinical schedules used in our institution. Tumor growth and survival were monitored. Flow cytometry was performed seven days after irradiation to characterize local and systemic T cell responses in tumors and spleens. For MF-SBRT, immune effects were also quantified at different timepoints, and a tumor rechallenge was performed in mice with complete tumor regression.

Results: Both SF and MF-SBRT regimens significantly reduced tumor size compared to controls, with a stronger effect observed for MF-SBRT. Upon rechallenge, secondary tumor growth rates did not significantly differ from controls, suggesting limited induction of long-term immune memory. These results were further investigated through flow cytometry, where significant increases in activated CD44+ and exhausted PD-1+ CD4+ and CD8+ tumor-infiltrating lymphocytes were observed for MF-SBRT compared to SF-SBRT and controls. This was amplified between day 3 and 7 following MF-SBRT. Similar immune remodeling patterns were found in the spleen.

Conclusion: MF-SBRT reduces tumor growth and increases T cell responses more effectively than SF-SBRT in a subcutaneous NSCLC mouse model, promoting a more immunogenic tumor microenvironment that may later exhibit signs of T cell exhaustion. These findings reinforce the hypothesis that SBRT, particularly when administered in a fractionated regimen, could benefit from combination with immune checkpoint inhibitors such as anti-PD-1 to sustain durable anti-tumor immunity.

OP-064

ORAL PRESENTATION - GENERAL SBRT
03-06-2026 16:15 - 17:15

LATTICE RADIOTHERAPY FOR BULKY AND RECURRENT HEAD AND NECK TUMORS: A INSTITUTIONAL EXPERIENCE

Lucas Caussa, Diego Fernandez, Caroline Descamps, Belen Raiden, Ariel Gomez Palacios, Ofelia Perez Conci, Ana Raies, Jose Gilardi, Franco Maciel, Carol Rios, Mariano Salum, Julieta Abate Daga, Camila Vargas, Ivan Charif Coll, Fernando Martini, Luciana Brun, Egle Aone, Edgard Falco, Edgardo Garrigo, Maria Diaz Vazquez, Gustavo Ferraris
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Background:
Lattice Radiotherapy (LRT) is an emerging spatially fractionated radiotherapy technique designed to enhance tumor response in large, unresectable, or recurrent solid tumors by delivering high-dose vertices within the tumor while maintaining acceptable toxicity in surrounding tissues. Objectives: To evaluate the feasibility, clinical outcomes, toxicity profile, and overall survival of patients with bulky or recurrent head and neck tumors treated with LRT.

Methods:
A retrospective review was conducted of 40 patients treated with LRT between 2020 and 2024 at Centro Médico Dean Funes (Córdoba, Argentina). Patients presented with large primary tumors or locoregional recurrence. Clinical, treatment, and TNM staging variables were recorded. Overall survival (OS) was calculated from the start of radiotherapy to death. Univariate and multivariate analyses were performed using a linear model with survival (months) as the dependent variable and stage, Lattice dose, total radiation dose, and chemotherapy use as covariates. Acute toxicities were graded using CTCAE v5.0.

Results:
Of the 40 patients included, 57.5% were stage IV and 25% were treated for recurrence. Among deceased patients (n=27), mean OS was 6.3 months (range 0.4–31.2). By tumor site, laryngeal carcinoma showed the longest survival (31.2 months), followed by parotid (10.2 months), paranasal sinus (8.5 months), hypopharynx (6.6 months), and tumors of unknown origin (6.1 months). Mean OS by stage was 7.1 months for stage IV and 4.7 months in recurrent disease. Multivariate analysis demonstrated an inverse association between Lattice dose and survival, likely related to indication bias. Acute toxicities were predominantly mucosal (n=22) and dermal (n=12); gastrointestinal toxicity occurred in 7 patients. Grade ≥3 events were uncommon, mainly mucosal (n=11) and dermal (n=7).

Conclusions:
LRT is feasible, safe, and well tolerated in bulky or recurrent head and neck tumors. Clinical outcomes appear encouraging in selected patients with advanced disease.

OP-065

ORAL PRESENTATION FUNCTIONAL & BEST OF THE REST
03-06-2026 16:15 - 17:15

LONG TERM RESULTS ON A LARGE COHORT OF PATIENTS TREATED BY CYBERKNIFE RADIOSURGERY FOR TRIGEMINAL NEURALGIA.

Isa Bossi Zanetti, Achille Bergantin, Anna Martinotti, Irene Redaelli, Livia Bianchi, Chiara Spadavecchia, Pantaleo Romanelli, Giancarlo Beltramo
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Objective We report a retrospective review regarding Cyberknife radiosurgery for trigeminal neuralgia (TN).

Materials and Methods The protocol aimed to deliver non-isocentric homogeneous irradiation (60 Gy) to an extended segment of the trigeminal nerve (6 mm) without hot spots. For resistant or recurrent pain a second treatment was performed with a lower dose (45 Gy). Pain control and sensory complications have been assessed using the BNI scales.

Results Retrospective review was conducted on 426 pts, with a mean follow-up of 62.5 months. Nerve compression by a vessel was found in 59.9% pts, contact but no evident compression in 21.6%, no contact in 18.5%. BNI pain score pre-treatment were IIIa in 2 pts (0.5%), IIIb in 7 (1.6%), IV in 186 (43%) and V in 235 pts (54.9%), while BNI facial numbness score was I in 398 (93.4%) and II in 28 (6.6%). 84 pts required retreatment after a mean follow-up of 23.1 months. Mean latency of pain relief was 3.2 months after the first treatment and 2 months after retreatment. At last follow-up satisfactory pain control (BNI scale I-IIIa) was achieved in 395 pts (92.7%) stable for a mean of 47.9 months. Sensory complications have been affected by retreatments: the rate of new not bothering facial numbness (BNI grade II) after single treatment was 12.8% while bothering paresthesias/disesethesias (BNI grade III and IV) appeared in 1%. The rate of BNI grade II, III and IV after retreatments were respectively 21.9% , 3% and 0.5% with an overall rate of 26.4%. The rate of bothering paresthesias/disesthesias following the treatment was 4.5% (1% after single treatment plus 3.5% after retreatment)

Conclusions Cyberknife is a safe and effective option to treat TN. Retreatments improve the overall rate of pain relief with minimal rate of sensory complications. These results compare favourably with other techniques.

OP-066

ORAL PRESENTATION FUNCTIONAL & BEST OF THE REST
03-06-2026 16:15 - 17:15

INTEGRAL DOSE AS A DETERMINANT OF SUSTAINED PAIN RELIEF AFTER GAMMA KNIFE RADIOSURGERY AS PRIMARY TREATMENT FOR TYPICAL TRIGEMINAL NEURALGIA

Adesh Shrivastava[1], Manjul Tripathi[2]
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Objective: The impact of integral dose ([ID] = mean dose x target volume) of the treated trigeminal nerve on the maintenance of pain relief in patients with idiopathic trigeminal neuralgia (TN) who underwent upfront Gamma Knife stereotactic radiosurgery (GKSRS) remains elusive.

Patients and Methods: A total of 78 patients who achieved the initial pain response following primary treatment with GKSRS for idiopathic trigeminal neuralgia were included in this study. Pain outcomes were assessed using the Barrow Neurological Institute Pain Scale (BNI-PS). Cox proportional hazards regression model was utilized to compute the prognostic factor with respect to the ID within the 50% isodose line. Facial pain relief maintenance interval was defined as time interval between the day of improved BNI grade and pain level back to the BNI-IV or V.

Results: The median duration of follow up was 42 months (range:6-108 months). The Patients achieved initial pain relief at a median of 0.5 months (range, 7 days to 6 months). Twenty-eight patients developed recurrence of pain. The median time to recurrence of pain was 17 months (range:2-60 months). There was a positive correlation between the pain relief maintenance increasing ID within 50% IDL (HR = 1.85, p = 0.04) on multivariable Cox-regression analysis. Using logistic regression analysis, Integral dose was not predictive of developing post-SRS hypoesthesia (p=0.64, HR: 1.057).

Conclusions: SRS needs to individualized based on trigeminal nerve morphology to achieve a durable pain relief in patients with trigeminal neuralgia. Integral dose calculation aids in planning optimal radiation dose based on the nerve morphology to give durable pain relief in idiopathic trigeminal neuralgia.

Abbreviations: ID: Integral dose, IDL: Isodose line, TN: Trigeminal Neuralgia, HR: Hazard ratio, SRS: Stereotactic radiosurgery, MVD: Microvascular decompression, BNI-PS: barrow Neurological Institute Pain Scale, mJ: Millijoules, GKSRS: Gamma knife stereotactic radiosurgery, cc; cubic centimeters

OP-067

ORAL PRESENTATION FUNCTIONAL & BEST OF THE REST
03-06-2026 16:15 - 17:15

NOVEL CONFORMITY INDEX FOR OPTIMIZATION OF TREATMENT PLANS

Hyun-Tai Chung
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Background: Radiosurgery requires optimal treatment plans to maximize tumor control and minimize side effects. The Paddick Conformity Index (PCI), the product of the Target Coverage Ratio (TCR) and the Selectivity Index (SI), is a standard metric.

Problem: PCI has limitations in selecting optimal plans. This stems from disparate component ranges: TCR is consistently high (0.95–1.00) with low variability, while SI shows greater variance (0.6–0.9). As PCI weights them equally, it is often dominated by the variable SI, potentially selecting plans with high selectivity at the expense of target coverage.

Methods: To address this imbalance, I first developed the Untreated Leakage Index (ULI), defined as ULI = (1–TCR)x(1–SI) = (1+TCRxSI) – (TCR+SI). While minimizing ULI could prioritize plans with excellent TCR, it proved overly sensitive to TCR values approaching 1.0. To mitigate this, I introduced a Rectified Conformity Index (RCI). This approach rectifies TCR and SI to new values (TCR', SI') by applying a ceiling value (cut-off). If the original value exceeds the cut-off, it is replaced by the cut-off; otherwise, it is retained. The RCI is then calculated using the ULI formula with these rectified values: RCI = (1+TCR'xSI') – (TCR'+SI').

Study Design: To compare, 30 plans were generated for 30 tumors. The top plan for each was selected by highest PCI and, separately, lowest RCI. The cut-off for TCR and SI was 0.996 and 0.990, respectively.

Results: RCI-based selection yielded mean (±SD) TCR, SI, and beam-on time of 0.996 +/- 0.001, 0.889 +/- 0.041, and 64.1 +/- 24.5min, respectively. PCI-based selection yielded 0.978 +/- 0.011, 0.939 +/- 0.022, and 98.6 +/- 38.0min, respectively.

Conclusion: RCI-based selection consistently identified plans with excellent target coverage (mean TCR > 0.995) and high selectivity (mean SI≈0.89). RCI-selected plans also had significantly shorter beam-on times, offering a more balanced, practical method for optimizing radiosurgery.

OP-068

ORAL PRESENTATION FUNCTIONAL & BEST OF THE REST
03-06-2026 16:15 - 17:15

COMPARATIVE ANALYSIS OF SINGLE-SESSION RADIOSURGERY FOR TRIGEMINAL NEURALGIA: GAMMA KNIFE VERSUS CYBERKNIFE OUTCOMES IN A RETROSPECTIVE COHORT STUDY

Denis Semenov[1,2], Andrey Golanov[1,2,3], Natalia Antipina[1], Elizaveta Makashova[1], Alexander Savateev[2,4], Valeriy Kostyuchenko[2,4], Irina Yurikova[1,2], Ivan Osinov[1,2], Evgeniya Novikova[2], Irina Sviridova[1]
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Introduction: Stereotactic radiosurgery (SRS) is a well-established treatment for drug-resistant trigeminal neuralgia (TN). Both Gamma Knife (GK) and CyberKnife (CK) platforms are widely used, yet direct comparisons of their clinical outcomes, including pain relief, durability, and complication profiles, remain limited.

Methods: We retrospectively analyzed data from 117 patients with TN of varying etologies treated between 2007 and 2025. Seventy-seven patients were treated on GK (single 4-mm isocenter, mean prescription dose 90 Gy) and 70 on CK (single fraction, mean maximum dose 85 Gy). Primary endpoints were pain cessation (assessed via Barrow Neurological Institute [BNI] Pain Intensity Scale scores I-III) and long-term efficacy (freedom from recurrence). Secondary endpoints included complications (facial hypesthesia, anesthesia dolorosa). Median follow-up was 25 months for GK and 36 months for CK.

Results: GK demonstrated superior early pain control at 6 months (BNI I-III, 76.9% vs. 70%, p=0.04) and a significantly faster onset of pain relief (median 3 weeks vs. 13 weeks, p=0.028). CK was associated with a higher incidence of facial numbness (32% vs. 14.2%). No cases of anesthesia dolorosa were recorded in either group.

Conclusions: Both GK and CK radiosurgery are effective for TN, but with distinct outcome profiles. GK provides faster and more pronounced initial pain relief with an acceptable complication rate. CK demonstrates earlier effect but a higher risk of sensory complications. These results underscore the importance of standardized, multidisciplinary evaluation (involving a neurologist, neurosurgeon, and radiation oncologist) for patient selection. Furthermore, standardized dosimetric comparisons between platforms are crucial to elucidate the relationships between dose distribution characteristics, efficacy, and toxicity, ultimately guiding optimal device-specific treatment strategies.

OP-069

ORAL PRESENTATION - INTRACRANIAL BENIGN
03-06-2026 11:30 12:30

LINAC BASED FRAMELESS SINGLE FRACTION VERSUS FRACTIONATED RADIOSURGERY FOR VESTIBULAR SCHWANNOMAS - A SINGLE INSTITUTION EXPERIENCE FROM A TERTIARY CANCER CENTRE ASSESSING HEARING PRESERVATION RATES , LOCAL CONTROL AND TOXICITY

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Purpose: Differentiating tumor recurrence from adverse radiation effect (ARE) after brain radiation remains challenging. We evaluated Treatment Response Assessment Maps (TRAM), which measure differential contrast extravasation and washout between 5 minutes to 50-105 minutes post gadolinium administration, to assess for tumor recurrence compared to ARE in the post-radiation treatment setting.

Methods: Patients who noted radiographic worsening after radiosurgery or definitive radiotherapy underwent TRAM, with or without additional spectroscopy and perfusion magnetic resonance imaging (MRI), from 2016 and 2025. Each imaging modality was scored as recurrence or ARE. Primary underlying etiology of recurrent tumor was considered evaluable if it met one of the following criteria: 1) pathologic confirmation; 2) continued radiographic progression of 3 months or longer with medical management; 3) continued clinical progression with medical management. Sensitivity, specificity, and accuracy were calculated for imaging modalities. Qualitative radiographic features were also assessed.

Results: A total of 52 patients with 55 brain lesions were assessed by TRAM. Of these, 21 patients with 22 lesions were able to be confirmed through pathology or clinical surveillance of the primary underlaying etiology which revealed 10 lesions confirmed as tumor and 12 were confirmed as ARE. TRAM alone achieved a sensitivity of 90.0 % and specificity of 91.7 % for detecting recurrence. MR spectroscopy alone (sensitivity 50 %, specificity 91.0 %), perfusion MRI alone (sensitivity 80.0 %, specificity 91.0 %) and the combined use of MR Spectroscopy and perfusion MRI (sensitivity 90.0 %, specificity 81.8 %) were relatively lower in diagnostic accuracy compared to TRAM alone. Combining criteria of TRAM interpreted as tumor recurrence and nodular lesion > 1 cm achieved 100% sensitivity.

Conclusions: TRAM demonstrated a high sensitivity and specificity in determining the presence of tumor recurrence after radiotherapy. Inclusion of TRAM in post-treatment imaging protocols may enhance the ability to facilitate earlier and potentially safer retreatment.

OP-070

ORAL PRESENTATION – INTRACRANIAL PEDIATRICS AND OCULAR
01-06-2026 11:30 12:30

RISK-ADAPTED STEREOTACTIC RADIATION FOR NF2-RELATED SCHWANNOMATOSIS: LESION-BASED PRESCRIPTION PATTERNS FOR MENINGIOMAS AND CRANIAL NERVE SCHWANNOMAS

Alejandro Rodríguez Camacho[1], Sergio Moreno-Jimenez[2], EVA HERNANDEZ NERI[1], Guillermo Gutierréz Aceves[1], Juan Romero Valencia[1], Laura Hernández Sánchez[2], Dharely Cid Sánchez[3], Talia Wegman Ostrosky[3], Enrique Caballé Pérez[3], Bernando Cacho Díaz[3], Oscar Arrieta-Rodríguez[4], Federico Maldonado Magos[3]
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BACKGROUND: NF2-related schwannomatosis (formerly neurofibromatosis type 2; NF2) is characterized by multiple intracranial tumors and often requires repeated focal therapies. Selection of single-fraction stereotactic radiosurgery (SRS) versus hypofractionated stereotactic radiotherapy (hSRT) across NF2-associated histologies remains poorly described.

METHODS: We retrospectively reviewed patients with clinically diagnosed NF2-related schwannomatosis treated with intracranial stereotactic radiation. A lesion-based dataset captured histology (meningioma vs cranial nerve schwannoma), location, prescription dose/fractionation, and treatment date. Courses were defined as unique treatment dates per patient. Follow-up was calculated from the most recent stereotactic course to the last clinical evaluation. Baseline and last follow-up Karnofsky Performance Status (KPS) were recorded. Imaging status at last assessment was categorized as stable, partial response, or progression based on REiNS documentation.

RESULTS: Eighteen patients (median age 32.5 years, range 18–47) were included. Median follow-up after the most recent stereotactic course was 12.3 months (range 1.0–80.3). Eight patients (44%) underwent ≥2 stereotactic courses (range 2–4). Seventy-eight tumors had analyzable prescription data (52 meningiomas, 26 schwannomas), with a median of 4 treated tumors per patient (range 1–12). Median baseline and last follow-up KPS was 80 (range 60–90). REiNS imaging status was evaluable in 17 patients: partial response in 8, stable in 6, and progression in 3. Meningiomas were predominantly treated with single-fraction SRS (36/52, 69%), most commonly 15 Gy/1 (23/52) and 16 Gy/1 (11/52); 12/52 (23%) received 3–5 fractions and 4/52 (8%) received ≥10 fractions. Cranial nerve schwannomas were predominantly treated with hSRT (20/26, 77%), most commonly 18 Gy/3 (10/26) and 25 Gy/5 (9/26); vestibular location accounted for 18/26 (69%).

CONCLUSIONS: In NF2-related schwannomatosis, stereotactic radiation followed a risk-adapted fractionation strategy with distinct prescription patterns between meningiomas and cranial nerve schwannomas. Multi-course stereotactic management was common with stable functional status at last follow-up.

E-POSTER PRESENTATION
ABSTRACTS

PP-001

E-Poster Viewing
CASE REPORT – BRAIN

LONG-TERM SURVIVAL AFTER STEREOTACTIC RADIOSURGERY FOR THALAMIC K27M-MUTANT GLIOBLASTOMA: A CASE REPORT

Andrey Golanov[1,2], Alexander Konovalov[3], Denis Semenov[3], Valeriy Kostyuchenko[3], Ivan Osinov[3]
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Objective: The H3K27M mutation in pediatric glioblastoma (pGBM) is associated with an aggressive course, low resection rates, and short overall survival after standard radiochemotherapy. Efficacy of temozolomide (TMZ) is limited by near-universal unmethylated MGMT promoter status. This case report examines long-term survival following salvage stereotactic radiosurgery (SRS).

Methods: A 13-year-old girl presented with a left thalamic tumor. Histopathology confirmed glioblastoma, WHO grade IV, with microvascular proliferation, necrosis, and Ki-67 of 40%. Molecular analysis identified an H3F3A K27M mutation (positive in 100% of cells), PDGFRA amplification, and an unmethylated MGMT promoter. Initial treatment involved subtotal resection (December 2001) and conventional radiotherapy.

Results: Eight months post-operatively, a local relapse was diagnosed. The patient underwent Gamma Knife radiosurgery (14 Gy to the 45% isodose) as the sole salvage therapy. No further systemic treatment was administered. Subsequent clinical and radiological follow-up with MRI/PET showed no evidence of tumor re-growth. At the last follow-up in September 2015 (165 months, or ~13.75 years, post-initial surgery), the patient remained clinically stable and socially integrated.

Conclusion: This unusual case of a histomolecularly aggressive, thalamic K27M-mutant pGBM demonstrates exceptional long-term disease control following salvage SRS for local relapse. While unique tumor biology may contribute, the outcome suggests SRS could be a potent local therapeutic option, particularly in tumors resistant to standard chemotherapy. This warrants further investigation in prospective trials for adjuvant or salvage treatment in H3K27M-mutant gliomas.

PP-002

E-Poster Viewing
CASE REPORT – BRAIN

“NO-NO” HEAD TREMOR AS A RARE NEUROLOGICAL MANIFESTATION OF METASTATIC BREAST CANCER

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Essential tremor most commonly affects the upper limbs, with isolated head or neck involvement reported in fewer than 10% of cases and occurring more frequently in women. Based on the direction of movement, head tremors are classified as horizontal (“no–no”), vertical (“yes–yes”), or mixed. Secondary causes of head tremor are uncommon and remain underreported, particularly in patients with advanced malignancy. We report a rare presentation of a horizontal (“no–no”) head tremor in a patient with metastatic breast cancer and central nervous system involvement. A 35-year-old woman, previously treated for right-sided invasive ductal carcinoma with neoadjuvant chemotherapy, modified radical mastectomy, and adjuvant radiotherapy in 2021, remained on regular follow-up until September 2024. She presented with vomiting and giddiness, and magnetic resonance imaging of the brain revealed diffuse supratentorial and infratentorial leptomeningeal enhancement. Subsequent PET-CT demonstrated a metabolically active lesion in the right temporal cortex with associated leptomeningeal and cervical spinal cord involvement. On the same day, she developed a prolonged generalized tonic–clonic seizure with post-ictal confusion and was admitted to the intensive care unit. Following stabilization, she developed rhythmic, low-amplitude horizontal head tremors consistent with a “no–no” pattern. Cerebrospinal fluid analysis revealed elevated protein levels and malignant atypical cells, confirming leptomeningeal metastasis. Repeat imaging showed a right temporal lesion with perilesional edema and extensive leptomeningeal disease. She was treated with intrathecal methotrexate followed by whole-brain radiotherapy but subsequently deteriorated and succumbed to the disease. This case suggests that malignant involvement of cerebellar and related neural pathways, particularly in the setting of leptomeningeal metastasis, may precipitate secondary essential tremor. Recognition of atypical tremor patterns in oncology patients is crucial, as they may represent an early or evolving manifestation of central nervous system disease. Multidisciplinary evaluation is essential for accurate diagnosis and management.

PP-003

E-Poster Viewing
CASE REPORT – BRAIN

IMMOBILIZING THE JAW DURING STEREOTACTIC RADIOSURGERY FOR LESIONS EXTENDING INTO THE REGION OF TEMPOROMANDIBULAR JOINT: AN INNOVATIVE APPROACH FOR A QUICK, REVERSIBLE, NON-INVASIVE, RADIOLUCENT AND RELIABLE FIXATION.

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All India Institute of Medical Sciences Bhopal, Neurosurgery, Bhopal, India

INTRODUCTION: Jaw fixation is usually required in patients undergoing GAMA Knife Surgery for extracranial lesions involving potentially mobile regions such as the temporomandibular joints (TMJ) the, the parapharyngeal spaces, and the craniocervial junction. As far as the immobilization of TMJ is concerned, there have been reports in the past on use of titanium screws in the maxilla and mandible for achieving this. But the invasive nature of the procedure and the metal artefacts are often a deterrant.

METHODS: A novel method was devised to do IMF with intermaxillary elastics on Non-Metallic aesthetics braces and used as pilot in this particular case. Possible options were either surgical with bone plating with titanium plates and screws along with Intermaxillary elastics or multibracket appliance bonding and for intermaxillary elastics. Routine metal braces were not advocated as they would interfere in MRI imaging process. The best possible option was to bond Polycarbonate braces on selected teeth and use elastics for intermaxillary elastics. After the procedure, brackets were removed with the help of debonding pliers assisted with thermal expansion. Adhesive was removed with Tungsten Carbide bur at the speed of 30000 RPM with air coolant.

FUTURE RECOMMENDATIONS: There should be special bracket kits for use in these types of cases. They should be easy to debond and should leave minimal damage on enamel after cleaning. Bracket manufacturing companies should make aesthetic brackets for all teeth including molars and these brackets should be equipped with hooks. It will facilitate in better engagement of elastics and better IMF.

PP-004

E-Poster Viewing
FRACTIONATION REGIMENS

CRANIOSPINAL IRRADIATION IN YOUNG ADULT PATIENTS WITH MEDULLOBLASTOMA: INSTITUTIONAL EXPERIENCE AND CLINICAL OUTCOME

Lucas Caussa, Franco Maciel, Jose Gilardi, Ariel Gomez Palacios, Ofelia Perez Conci, Belen Raiden, Carol Rios, Ana Raies, Luciana Brun, Julieta Abate Daga, Camila Vargas, Fernando Martini, Ivan Charif Coll, Mariano Salum, Caroline Descamps, Egle Aone, Edgard Falco, Edgardo Garrigo, Diego Fernandez, Maria Diaz Vazquez, Gustavo Ferraris
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Background:
Medulloblastoma (MB) is the most common malignant brain tumor in children, whereas its incidence in adolescents and young adults (AYA) is low, posing unique diagnostic and therapeutic challenges. Craniospinal irradiation(CSI) remains a fundamental component of multimodal treatment, yet outcome data in AYA patients are limited. This study assesses survival outcomes, disease control, and treatment tolerance in AYA patients with MB treated with CSI at a single institution.

Methods:
A retrospective analysis was conducted of AYA patients treated with surgery, chemotherapy(CT), and CSI using volumetric-modulated arc therapy(VMAT) from August 2016 to August 2024 at the Deán Funes Radiotherapy Center (Córdoba, Argentina). Demographic, clinical, treatment, and toxicity data were collected. CSI was delivered with daily fractions of 2 Gy to a total dose of 36 Gy to the craniospinal axis, followed by a boost to 54 Gy. Outcomes included overall survival (OS), progression-free survival (PFS), and acute toxicity.

Results:
Ten patients were analyzed, with a mean age of 26 years (range 15–39) and ECOG performance status 0–2. Histologies included classic and desmoplastic variants. Sixty percent had localized disease (M0), and 70% received concurrent CT during CSI. After a median follow-up of 27 months, 70% of patients were alive and 60% remained progression-free. The mean irradiated craniospinal volume was 2200 cc (range 1763–2400). Grade 1 toxicity occurred in 70% of patients, predominantly nausea. Two patients (28%) who received concurrent CSI and CT developed thrombocytopenia requiring transfusion support. No treatment interruptions occurred.

Conclusion:
This series demonstrates that CSI in AYA patients with MB achieves OS, PFS, and tolerance outcomes comparable to international reports. Particular attention is warranted in patients receiving concurrent CT due to the risk of hematologic toxicity, as portions of irradiated bone contain active marrow reserves. These findings emphasize the importance of multidisciplinary management and vigilant supportive care in this population.

PP-005

E-Poster Viewing
FUNCTIONAL SRS (PAIN, EPILEPSIES, TREMOR, PSYCHIATRY)

EFFECTIVENESS OF GAMMA KNIFE STEREOTACTIC RADIOSURGERY FOR TRIGEMINAL NEURALGIA WITHOUT APPARENT RESPONSIBLE VESSELS ON MRI

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Objective: Gamma knife stereotactic radiosurgery (GKRS) has been reported as a safe and effective treatment for trigeminal neuralgia (TGN). Cease or decrease of pain may be achieved in 80-90% of patients. Effectiveness of GKRS was retrospectively investigated in a subgroup of patients with TGN without apparent responsible vessels, such as offending arteries, on MRI in this study. Materials and

Methods: No apparent responsible vessels causing TGN were detected in 17 cases, 5 males and 12 females, among 113 treated by GKRS for TGN in Ookuma Hospital from July, 2016 through June, 2024. The mean age was 64.4 years. The mean period between occurring TGN and GKRS was 7.3 years. Microvascular decompression surgery had been done only in one case. A single dose of 70 to 80 Gy was delivered at the retrogasserian portion or the root entry zone of the ipsilateral trigeminal nerve using Gamma Knife.

Results: Follow up periods more than 12 months was obtained in 14 cases among 17. 9 cases of 14 achieved symptom elimination or relief within 12 months. 3 cases of 5 with little symptom improvement achieved symptom relief within 24 months. In three cases among 14 TGN recurred between 12 and 24 months. Repeat GKRS was performed in two cases and medication was added in one case. Two patients who underwent re-irradiation experienced pain relief within three months of irradiation. Cease or decrease of pain was achieved in 13 cases of 14 , but only two patients were able to discontinue medical therapy.

Conclusions: GKRS was a safe and effective treatment for TGN without apparent responsible vessels on MRI.

PP-006

E-Poster Viewing
FUNCTIONAL SRS (PAIN, EPILEPSIES, TREMOR, PSYCHIATRY)

HIGHER DOSE RATES IMPROVE PAIN RELIEF IN LINAC-SRS FOR TRIGEMINAL NEURALGIA: A RETROSPECTIVE ANALYSIS

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Purpose: Trigeminal neuralgia is a severe facial pain syndrome that can be managed with surgical or stereotactic radiosurgical (SRS) deafferentation. While the radiation dose needed is well established, the dose rate required remains controversial. We evaluated the effect of dose rate on pain relief in patients undergoing linear accelerator stereotactic radiosurgery (linac-SRS) for trigeminal neuralgia (TN).

Methods: A retrospective review was conducted of 134 linac-SRS treatments for TN performed by a single team at one institution between 2003 and 2017. Sixteen repeat procedures were excluded. Each treatment prescribed 40 Gy to the 50% isodose line, with a maximum point dose of 80 Gy, targeting the proximal trigeminal nerve root. Treatments were delivered at either 800 monitor units (MU)/min or 2400 MU/min, corresponding to approximately 4 Gy/min and 12 Gy/min. Clinical outcomes were assessed using the Barrow Neurological Institute (BNI) pain intensity and facial numbness scales. Univariate and multivariate analyses examined the effects of age, multiple sclerosis comorbidity, time from diagnosis to treatment, prior procedures, and dose rate. Dosimetric consistency and isocentre placement across all plans were also reviewed to evaluate potential impact on outcomes.

Results: Kaplan-Meier analysis and log-rank testing demonstrated significantly improved pain relief (BNI grades I-III) with the higher dose rate (p=0.003). Cox proportional hazards modeling identified dose rate as the only statistically significant factor, with a hazard ratio of 3.07 (95% CI: 1.38–6.83, p=0.006). The dose prescription was identical for both groups. Dose-volume histograms and mean dose were comparable for the trigeminal nerve, brainstem and cranial nerves VII and VIII between the two cohorts. Isocenter placement and mean dose consistency confirmed geometric and dosimetric reproducibility, with treatment delivery comparable across cohorts.

Conclusion: Higher dose rates using linac-SRS for TN were associated with significantly better patient outcomes.

PP-007

E-Poster Viewing
FUNCTIONAL SRS (PAIN, EPILEPSIES, TREMOR, PSYCHIATRY)

SAFETY AND EFFECTIVENESS OF FRAMELESS LINAC-BASED STEREOTACTIC RADIOSURGERY ON TREMOR IN PATIENTS WITH ESSENTIAL TREMOR OR PARKINSON'S DISEASE (TREMOR TRIAL)

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Background: Essential Tremor (ET) and tremor-dominant Parkinson's disease (TD-PD) frequently lead to significant disability, often proving refractory to conventional pharmacotherapy. While Deep Brain Stimulation (DBS) and Radiofrequency (RF) thalamotomy are effective, they are invasive and carry risks that preclude treatment for many patients, particularly the elderly or those with comorbidities. There is a need for highly effective, non-invasive ablative techniques. Frameless linear accelerator (LINAC)-based Stereotactic Radiosurgery (SRS) offers a compelling, single-session alternative to conventional surgery.

Aims: The Phase II TREMOR trial aims to investigate the safety, efficacy, and feasibility of frameless LINAC-based SRS thalamotomy targeting the ventral intermediate nucleus (VIM) for patients with medically refractory ET or TD-PD.

Methods: This is a prospective, single-arm, investigator-initiated study (ANZCTR Reg. ID: 380238) conducted at Icon Cancer Centre, Richmond. The trial will enrol 30 participants who are over 18 years old with disabling, medication-refractory ET or TD-PD and are unsuitable for invasive surgical options. The intervention involves a single 130Gy radiation fraction delivered to the VIM nucleus using a frameless LINAC system. The primary endpoint is the proportion of participants achieving clinical improvement in tremor severity at 3, 6, and 12 months post-treatment, assessed using the Fahn-Tolosa-Marin Tremor Rating Scale (FTM). The secondary endpoints are safety and tolerability of the treatment, tremor severity using the tremor rating assessment scale (TETRAS), measures of activity of daily living (PROMIS and TETRAS ADL subscale) and patient-report quality of life measures (QUEST, PDQ-8, EQ-5D-5L). Preliminary data from the first 6 participants will be presented.

Conclusion: The TREMOR trial is pioneering the non-invasive use of LINAC-based SRS for movement disorders in the Australian context. Should this study demonstrate favourable safety and efficacy comparable to established ablative methods, it would provide a highly accessible, non-surgical treatment option for a high-risk patient population currently underserved by existing therapies.

PP-008

E-Poster Viewing
IMAGING FOR RADIOSURGERY (E.G. MR-LINAC, OTHERS)

MULTI-METRIC SOLUTION FOR EVALUATING MAGNETIC RESONANCE IMAGING DISTORTION CORRECTION IN CRANIAL STEREOTACTIC RADIOSURGERY

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Introduction: In Stereotactic Radiosurgery (SRS), sub-millimeter accuracy is a critical factor. While Magnetic Resonance Imaging (MRI) is the most adequate imaging for defining targets, its inherent geometric distortions can compromise treatment accuracy, particularly in functional radiosurgery, where radioablation of the target does not allow for additional dose margin. Checking the distortion correction algorithms during treatment planning is required, but remains challenging to evaluate due to the complex nonlinear nature of magnetic fields. This study introduces a flexible, software-based quality assurance method relying on virtual phantoms to check correction accuracy, with the possibility to include dedicated phantom and/or clinical data.

Materials and Methods: We developed a Python program to generate artificial contrast-enhanced lesions in cranial MRI scans, simulated clinical datasets with different levels of intensity non-uniformity (RF) and noise, using the validated BrainWeb simulation process, and a synthetic CT (sCT) scan from the original MRI, serving as our ground-truth reference. Distorted datasets were processed using a commercially available multi-rigid registration algorithm. The effectiveness of the distortion correction was measured using multiple full-image and local volumetric comparison metrics.

Results: The results show that distortion correction improved image correlation across datasets. Corrected images had better spatial agreement with the reference sCT than uncorrected scans. Global and local metrics consistently showed improved spatial data, clearly showing how well the algorithm performed, even with higher RF and noise.

Conclusion: This methodology provides a proven, adaptable, and accessible way to set up and routinely check MRI distortion correction tools. By removing the need for extra equipment or imaging time, this software approach allows for more frequent and detailed validity checks. This helps ensure that SRS planning uses precise and accurate data for treatment delivery, leading to decreased geometric uncertainty in defining targets for critical cranial functional treatments.

PP-009

E-Poster Viewing
IMAGING FOR RADIOSURGERY (E.G. MR-LINAC, OTHERS)

EVALUATION OF A COMMERCIAL SYNTHETIC-CT FOR SRS BRAIN TREATMENTS

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Summary Conventional brain radiotherapy and SRS workflows rely on both CT and MRI acquisitions: CT provides electron density information for dose calculation, while MRI offers superior soft tissue contrast for accurate target delineation. However, the co-registration of CT and MRI introduces geometric uncertainties in the treatment planning process. A [LM1] MR-only workflow using a synthetic CT (sCT) could eliminate these uncertainties by relying solely on MRI data for both contouring and dose calculation. This study aims to evaluate a commercially available brain-specific sCT solution in a clinical setting.

Patients and Methods Cohort included 47 patients treated with SRS for brain metastases, meningiomas or vestibular schwannomas who underwent both planning CT and MRI in treatment position. sCT images were generated and CT reference plan was recalculated on sCT images. sCT performance was evaluated based on image quality metrics (Mean Absolute Error and Mean Error) for Hounsfield Units comparison, on dose accuracy metrics at various dose-volume histogram points and gamma analysis, and on organ-at-risk auto segmentation accuracy with Dice Similarity Coefficient.

Results • Metastases: Most cases showed excellent dosimetric agreement (±1%) and acceptable sCT quality. Bone reconstruction was less accurate near postoperative cavities. **• Vestibular schwannomas**: Good dosimetric correlation. However, imperfect bone reconstruction in temporal bone led to inaccurate cochlea contour and targets delineation. **• Meningiomas**: While overall dosimetric agreement was good, attention should be paid to challenging sites, such as bone or air interfaces. Lesions involving the nasal cavities were found to be not suitable for MR-only workflows.

Conclusion
This study supports the feasibility of MR-only workflows using sCT for selected brain tumor cases. Limitations related to specific anatomical contexts must be carefully considered to ensure treatment accuracy. As CT is often used for QA for MR distrostion, further investigation is needed to evaluate whether using sCT only increases the distorsion risk.

PP-010

E-Poster Viewing
IMAGING FOR RADIOSURGERY (E.G. MR-LINAC, OTHERS)

64CU-DOTATATE PET/MRI FOR RADIOSURGERY PLANNING IN HEAD AND NECK PARAGANGLIOMAS

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Introduction:
Paragangliomas are uncommon neuroendocrine tumors that often develop near critical neurovascular regions of the head and neck. Stereotactic radiosurgery (SRS) represents a safe and effective treatment option for these tumors. However, accurate tumor delineation is essential to optimize radiation targeting and minimize toxicity. The radiotracer ^{64}Cu-DOTATATE positron emission tomography (PET) has recently emerged as a highly sensitive modality for detecting paragangliomas. This study evaluates how integrating ^{64}Cu-DOTATATE PET with magnetic resonance imaging (MRI) influences radiotherapy planning and target contouring in SRS.

Methods:
A retrospective review identified patients with non-metastatic head and neck paragangliomas treated with SRS using ^{64}Cu-DOTATATE PET/MRI fusion imaging over a 20-month period. Demographic, radiographic, treatment, and clinical data were collected at baseline and most recent follow-up. Tumor volumes obtained from pre-treatment MRI alone were compared with those derived from PET/MRI fusion using a Wilcoxon signed-rank test, with statistical significance set at $p < 0.05$.

Results:
Seven patients (five women and two men; median age, 56 years; range, 41–86) were included. Presenting symptoms included hearing loss in three patients (42.9%) and tinnitus in two (28.6%). Cranial nerve deficits were documented in five patients (71.4%), involving CN XII (n = 2), CN X (n = 2), and CN VII (n = 1). SRS was delivered via Gamma Knife (n = 5) or LINAC (n = 2). Post-treatment complications included cerebrospinal fluid otorrhea in two patients (28.6%) and throat dryness in one (14.3%). At an average follow-up of 13 ± 2 months (n = 5), all patients demonstrated stable or improved disease. The mean tumor volume delineated on MRI alone was 8.5 ± 2.7 cm^3, which increased to 10.7 ± 3.4 cm^3 following PET/MRI fusion ($p = 0.016$).

Conclusion:
^{64}Cu-DOTATATE PET/MRI fusion enhances visualization of paraganglioma extent, allowing more comprehensive target definition in SRS planning.

PP-011

E-Poster Viewing
IMAGING FOR RADIOSURGERY (E.G. MR-LINAC, OTHERS)

CONTRAST-ENHANCED 3D T1 BLACK-BLOOD MRI ENHANCES TARGET DELINEATION IN SRS

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Purpose:
This study aimed to evaluate the feasibility and clinical utility of contrast-enhanced (CE) three-dimensional (3D) T1-weighted black-blood (BB) MRI in improving gross tumor volume (GTV) delineation and treatment planning for Zap-X stereotactic radiosurgery (SRS) in patients with brain metastases or tumors near critical vascular structures, compared with conventional CE 3D T1 gradient-echo (GRE) imaging.

Materials and Methods:
Twenty patients with suspected brain metastases or vascular-adjacent tumors underwent high-resolution BB-MRI and CE-GRE imaging between June 2024 and March 2025 using a 3.0 T scanner (Ingenia Elition X 3.0 T; Philips Healthcare). Imaging included T2 turbo spin echo (TSE), 3D T2 TSE, 3D T1 GRE, CE 3D T1 GRE, and CE 3D T1 BB TSE sequences. Following gadoteridol (ProHance; 0.2 mmol/kg) injection, CE 3D T1 GRE and BB-MRI images were sequentially acquired. GTV delineation was independently performed on fused planning CT with both CE 3D T1 GRE and BB-MRI. Lesion conspicuity, delineation confidence, target volume differences, and the impact on SRS planning were analyzed, alongside radiation planning indices such as the Conformity Index (CI), Gradient Index (GI), and Homogeneity Index (HI).

Results:
CE BB-MRI provided superior suppression of vascular signals compared to CE 3D T1 GRE, improving visibility of metastatic lesions and perivascular tumor infiltration. GTV delineations using BB-MRI were smaller, more precise, and showed reduced interobserver variability. Preliminary planning metrics indicated improved targeting with BB-MRI. Lesions adjacent to major cerebral vessels showed clearer margins, allowing for more accurate SRS planning with tighter planning target volume (PTV) margins.

Conclusion:
CE 3D T1 BB-MRI improves tumor visualization and GTV delineation for brain metastases and tumors near vascular structures, enhancing Zap-X SRS planning accuracy and safety.

PP-012

E-Poster Viewing
INTEGRATION OF MULTIMODALITY IMAGING (FMRI, MEG, PET)

GAMMA KNIFE RADIOSURGERY WITH PET-CT AND MRI CO-REGISTRATION FOR RECURRENT NASOPHARYNGEAL CARCINOMA: A 14-YEAR SINGLE-CENTER RETROSPECTIVE ANALYSIS

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Objective:
Recurrent nasopharyngeal carcinoma (NPC) after definitive radiosurgery or prior high-dose radiation exposure remains a major therapeutic challenge because of anatomical complexity and limited salvage options. This study aimed to evaluate the long-term clinical outcomes of Gamma Knife radiosurgery (GKS) using PET-CT and MRI co-registration for precise target delineation in patients with recurrent NPC.

Materials and Methods:
Between 2005 and 2018, ten patients with recurrent NPC underwent GKS at a single tertiary institution. All patients had previously received radiation-based local treatment to the nasopharyngeal region and were treated with stereotactic radiosurgery as salvage therapy. Treatment planning incorporated co-registration of PET-CT and contrast-enhanced MRI to optimize tumor target definition. The median target volume was 8.2 cm^3 (range, 1.7–17.8 cm^3), and the median prescribed marginal dose was 18 Gy (range, 12–30 Gy). Clinical and radiological follow-up was performed using serial MRI and PET-CT imaging. Overall survival (OS) and local failure-free survival (LFFS) were estimated using the Kaplan–Meier method.

Results:
Patterns of recurrence included local nasopharyngeal recurrence in 70% of patients, intracranial extension in 10%, and distant brain metastases in 20%. The median follow-up duration was 18 months (range, 6–76 months). Local failure following GKS occurred in 50% of patients. The 1- and 3-year OS rates were 90% and 77%, respectively. LFFS rates at 6 months, 1 year, and 3 years were 80%, 48%, and 32%. No clinically significant radiation-induced toxicity or neurological complications were observed. PET-CT/MRI co-registration during radiosurgical planning was significantly associated with improved local control on univariate analysis ($p = 0.027$).

Conclusion:
Gamma Knife radiosurgery is a feasible and safe salvage treatment option for recurrent nasopharyngeal carcinoma. The integration of PET-CT and MRI co-registration enhances target accuracy and may contribute to improved local tumor control. Advanced image-guided radiosurgery should be considered in the multidisciplinary management of recurrent NPC.

PP-013

E-Poster Viewing
PHYSICS

SINGLE BRAIN METASTASIS RADIOSURGERY: DOSIMETRIC COMPARISON OF COPLANAR AND NON-COPLANAR VMAT TECHNIQUES

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Introduction: In radiosurgery for single brain metastases(BM), the advantage of using non-coplanar fields in terms of dose falloff and conformity to the peak volume (PV) has been reported. However, the need to rotate the treatment table and the difficulty in obtaining positioning images in certain table positions can lead to inaccuracies during treatment. This paper proposes dosimetric comparison coplanar and non-coplanar, using volumetric intensity-modulated arc therapy(VMAT).

Method:
Twelve patients with a single BM (PTV3.3 ± 2.0 cc) were selected. The prescribed dose was 20Gy/1fr, two treatment plans were optimized using coplanar VMAT and non-coplanar on the Eclipse TPS (Varian). All plans were normalized 95% of the PTV received 100% of the prescribed dose.
The resulting plans were evaluated considering: conformity index(CI) (RTOG and Paddick), gradient index(GI), high doses(≥105%) outside the PTV, homogeneity index, PTV coverage, and homogeneity of coverage. The number of radiation units (MUs) and total irradiation time were also evaluated for each modality. Doses received by the healthy brain were compared.

Results:
Both plans met the internationally recommended medical and physical acceptance criteria. CI (RTOG) values of 0.98 and 1.05 were obtained, CI values 0.87. Homogeneity indices were slightly better with non-coplanar VMAT. Units of treatment (UM) and irradiation times were reduced by 27.1% and 18.7%, respectively, with non-coplanar VMAT, but the time required for table rotations or additional images was not taken into account. V12Gy and V10Gy of healthy brain were 23.6% and 9.0% lower with coplanar VMAT.

Conclusions: This study confirm the possibility of slightly improving dose homogeneity and limiting low doses by using non-coplanar arcs. However, in terms of protecting healthy brain tissue, coplanar VMAT was superior in all patients, making this technique a viable treatment option. This analysis is particularly important when considering radiosurgery with equipment that does not allow for table rotation, as in tomotherapy.

PP-014

E-Poster Viewing
PHYSICS

MINIMISING BODY DOSE IN STEREOTACTIC RADIOSURGERY

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Introduction

Although stereotactic radiosurgery (SRS) is highly targeted, low-dose body scatter can contribute to secondary cancer risk, particularly in younger or benign-disease working-age patients with long life expectancy [1]. The latest NHS SRS service specification sets extracranial dose limits for patients with the highest lifetime risk [2]. This study evaluates how to implement these recommendations in clinical practice and minimise patient dose from SRS.

Method

The low-dose calculation accuracy of the Monte Carlo (MC) algorithm was validated for two treatment planning systems (TPS): Monaco (Elekta) and Elements (Brainlab). A phantom representing the patient's upper body was created, and doses at depths of 25–30 cm and out-of-field locations were measured using TLDs on a Varian TrueBeam linac. Clinically relevant treatment plans with varying target sizes and locations were optimised on the phantom using non-coplanar arcs and exit-dose minimisation techniques.

Results

TPS predictions were accurate within 26.5% for Monaco and 24.5% for Elements, outperforming previously reported scatter dose uncertainties [3]. Fifteen SRS plans emulated in Elements remained clinically acceptable and deliverable, with doses at 30 cm from the target kept below 10 mGy.

Conclusion

Elements and Monaco MC algorithms can assess body dose from SRS within known uncertainties. Clinically viable SRS plans for C-arm linacs can be optimised to substantially reduce body dose without compromising treatment quality. Given documented scatter-induced cancer risks, especially in younger patients, such dose-minimisation strategies are clinically important and warrant wider adoption.

References: [1] Paddick I, et al. Extracranial dose and the risk of radiation-induced malignancy after intracranial stereotactic radiosurgery: is it time to establish a therapeutic reference level? Acta Neurochir (Wien). 2021;163(4):971-979. [2] NHS service specification: Stereotactic Radiosurgery and Stereotactic Radiotherapy (Intracranial), https://www.england.nhs.uk/publication/service-srs-intracranial-all-ages/ [3] Sánchez-Nieto B, et al. Study of out-of-field dose in photon radiotherapy: A commercial treatment planning system versus measurements and Monte Carlo simulations. Med Phys. 2020;47(9):4616-4625.

PP-015

E-Poster Viewing
PHYSICS

EVALUATION OF MULTIPLE DETECTOR RESPONSE UNDER UHDR FLASHKNIFE ELECTRON BEAMS

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Introduction Reliable dosimetry under ultrahigh dose rate (UHDR) conditions is critical for translating FLASH radiotherapy into clinical practice. Conventional ionization chambers suffer from recombination effects, whereas solid-state diodes and diamond detectors promise faster and potentially more accurate readings. This study presents initial measurements comparing multiple detector types across varying FLASHKNiFE delivery parameters.

Materials and methods Irradiations were performed using the FLASHKNiFE system (Theryq, France) with a 10 cm diameter circular field. Four irradiation conditions were evaluated: (1) pulse repetition frequency (PRF) 300 Hz, pulse width (PW) 3µs, 2 pulses; (2) PRF 100 Hz, PW 1µs, 6 pulses; (3) PRF 300 Hz, PW 1 µs, 6 pulses; (4) conventional 9 MeV beam with 358 monitor units to yield a matched dose. Detectors included the FlashDiamond, a SiC prototype diode, Razor diode, and a prototype PPC05. A consistent buildup was applied.

Results Figure1 shows the normalized charge of each of the 4 detectors over the 4 investigated conditions. With the exception of the Razor diode in Condition 4, all detectors demonstrated stable behavior, with normalized values within ±3% of their detector-specific means (0.98–1.03). This narrow range suggests that variations in dose rate, dose per pulse, and pulse structure had limited influence on the relative detector output under the tested conditions. The low spread and standard deviations confirmed repeatable and configuration-insensitive performance in the pre-calibration stage. The razor diode exhibited a systematic decrease with decreasing dose per pulse and average dose rate. This response is consistent with other diode studies which demonstrated decreased sensitivity with decreasing average and instantaneous dose rates, likely due to charge recombination effects.

Conclusion
These preliminary results demonstrated that most tested detectors exhibit stable and repeatable performance across diverse FLASHKNiFE delivery settings. Further work, including absolute dose verification, will support robust UHDR dosimetry for FLASH clinical

development.

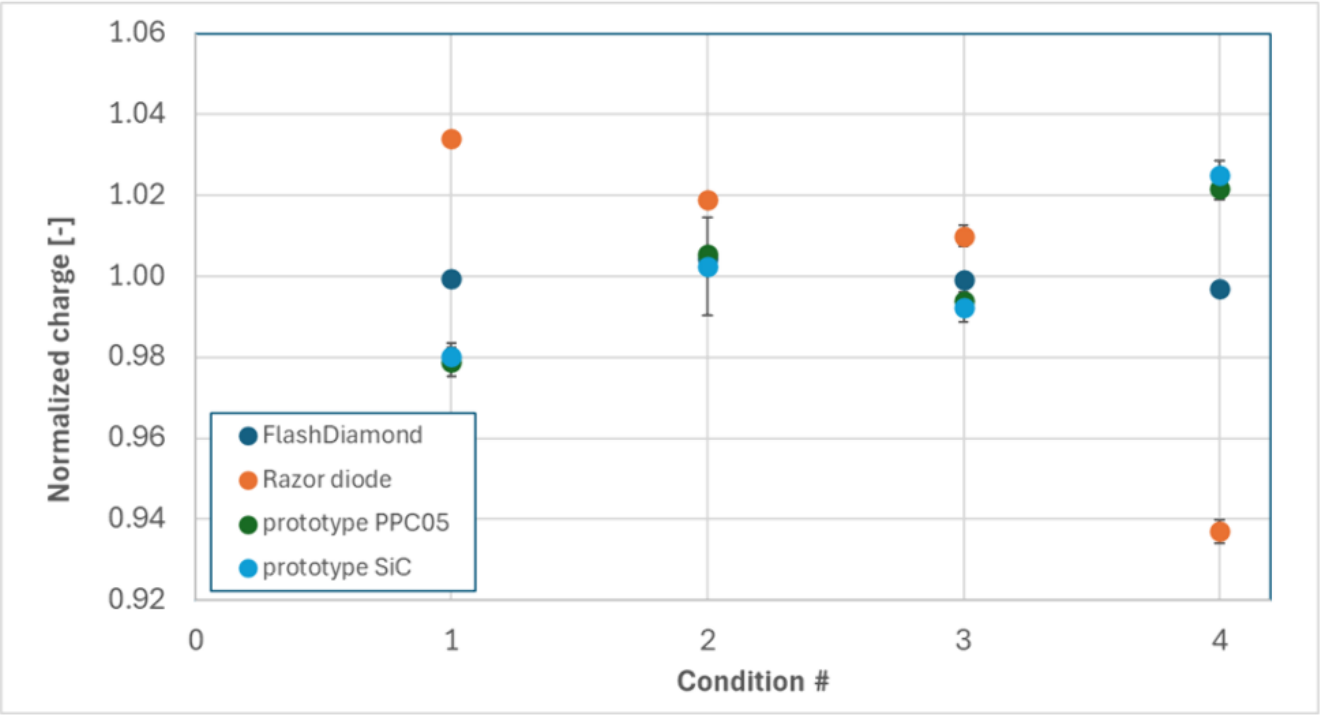

Figure 1. Response of the Flash Diamond, razor diode, prototype PPC05 and SiC detectors across all four conditions. The mean charge per condition was normalized to the detector-specific mean across all conditions to evaluate dose, dose-rate, and dose-per-pulse dependence. Error bars correspond to the normalized standard deviation of the repeated measurements for each condition.

PP-016

E-Poster Viewing
PHYSICS

USING G-FRAME ANGLES IN GAMMA KNIFE RADIOSURGERY FOR INTRACANAL VESTIBULAR SCHWANNOMAS

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Introduction: The G-frame angle can simplify the process of planning Gamma Knife radiosurgery (GKRS). Selecting an optimal G-frame angle can help avoid collisions and reduce dose to organs at risk (OARs). This study investigates intracanal vestibular schwannoma (VS) planning technique utilizing adjustments to minimize the radiation dose to the cochlea. The objective was to assess whether this optimization could achieve meaningful cochlear dose reduction without degrading quality parameters of the treatment plan.

Materials and Methods: The analysis was conducted on a cohort of 10 patients with intracanal vestibular schwannomas. For each case, two distinct Gamma Knife treatment plans were created: a standard clinical plan using conventional frame coordinates, and an angle plan employing frame angle adjustments specifically aimed at reducing beam intersection with the cochlea. The plans were compared using standard dosimetric metrics, including minimum dose, coverage, selectivity, gradient index, and the percentage volume of the cochlea receiving 4 Gy (V4Gy) and 6 Gy (V6Gy). Statistical comparison was performed by one-way ANOVA.

Results: The analysis revealed no statistically significant difference between the standard and angle plans in terms of the target minimum dose, coverage, selectivity and gradient index (one-way ANOVA p-values were 0.8579, 1, 0.7813 and 0.8882, respectively. The cochlea V4Gy showed no significant change (p-value = 0.1135). However, a statistically significant reduction was achieved in the cochlea V6Gy (p-value = 0.0354).

Conclusion: Using the G-frame angles is a valuable strategy in Gamma Knife treatment planning for VS patient as it gives improved treatment plans with lower cochlear doses. This technique achieves a significant decrease in cochlear V6Gy without adversely affecting the coverage, selectivity and gradient index. This approach holds potential to improve hearing preservation rates, offering a practical method that can be seamlessly incorporated into the standard radiosurgical workflow.

PP-017

E-Poster Viewing
PHYSICS

OPTIMIZATION OF SRS PLANS USING PSEUDO-STRUCTURES FOR LOW-DOSE CONTROL IN LEKSELL GAMMA PLAN

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Introduction: In stereotactic radiosurgery (SRS), protecting organs at risk (OARs) is a crucial objective. The Leksell Gamma Plan automatic plan optimizer Lightning effectively limits the maximum dose (*Dmax*) to OARs, but doesn't allow the user to control the volume receiving lower but clinically relevant doses (e.g., 12 Gy). In this study we present and validate a novel stepwise optimization method designed to reduce these low-dose volumes without compromising key plan quality metrics.

Materials and Methods: Ten patient SRS plans (18-30 Gy prescription dose) for various intracranial targets were analyzed. Firstly, standard optimization with *Dmax* constraints on critical structures (brainstem, optic nerves) was performed. Then the 12 Gy isodose contour within each OAR was used to create a new, interior pseudo-structure. Lastly, the optimizer was used again with additional reduced *Dmax* constraints (10.5–11.5 Gy) for this pseudo-structure. Plan quality was assessed by comparing the OAR *V12Gy*, OAR *Dmax*, Paddick Conformity Index (*PCI*), and target coverage between the initial and final plans.

Results: Application of the method demonstrated a statistically significant reduction in the *V12Gy* for all critical OARs ($p<0.05$). Crucially, there was no clinically significant deterioration in the primary plan parameters: target coverage and *PCI* were maintained, and the *Dmax* to the original OARs did not increase significantly.

Conclusions: The proposed two-step optimization technique, utilizing dose-defined pseudo-structures, provides precise, user-directed control over low-dose volumes to OARs in Gamma Plan. It directly addresses a key limitation of the standard optimizer. The method enables a reproducible reduction in volumes receiving 12 Gy without degrading target conformity or coverage, potentially reducing the risk of radiation-induced complications and enhancing patient safety. This approach requires no additional software, and is easily integrated into existing clinical workflow.

PP-018

E-Poster Viewing
PHYSICS

SPHERICITY IMPACT ON RADIATION DOSE TO THE COCHLEA

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Introduction: Gamma Knife Radiosurgery(GK-SRS) is accepted as the standard of care for selected Acoustic Neurinomas(ANs). Cochlear radiation level appears to influence hearing preservation. Irregularly shaped tumors are more challenging to maintain conformity and to keep the cochlear dose within acceptable constraints. **Objective:** Define if Acoustic Neuroma sphericity (ϕ) (i.e., "tumor roundness") influences cochlear dose during GK-SRS, without compromising tumor coverage**.**

Methodology: Acoustic Neurinoma databases at two independent GK Centers (HCor/São Paulo, and DF-Star Rede D'Or/Brasilia) from January/2018 to December/2024 were analyzed. All tumors and cochleas were recountoured using the FIESTA sequence by the same neurosurgeon. All cases were planned solely using the GK Lightning software™. ANs were retrieved and included only if the maximal distance between the tumor and the cochlea was <= 2mm. The sphericity index was calculated utilizing the following equation: $\phi = \sqrt[3]{}$volume of the tumor/volume of the smallest sphere that circumscribes the tumor Two groups were defined: <0.7(low sphericity, 73 tumors) and ≥0.7(high sphericity, 52 tumors). The χ^2-test significance level was set at 0.05.

Results: One hundred twenty-five ANs matched the study inclusion criteria. The difference between the medians of the low- and high-sphericity groups for the maximum cochlear dose was 0.2Gy. Comparatively, it was 0.55Gy for the mean cochlear dose. The difference between the high- and low-sphericity groups' averages for maximum cochlear dose was negligible at 0.08Gy. The mean cochlear dose difference was 0.46Gy. The results for the Chi-Squared tests were a p-value=0.102 for mean cochlear dose and a p-value=0.112 for maximum cochlear dose.

Conclusion: Planning for rounder tumors did not decrease cochlear doses. Irregularly shaped tumors challenge the algorithm in shaping tumor dose while limiting cochlear dose, but it still proved robust enough to provide acceptable cochlear dosage. The GK Lightning algorithm compensates for irregularly shaped tumors, preventing low-sphericity tumors from impacting the cochlear dose.

PP-019

E-Poster Viewing
PHYSICS

EFFECT OF LEAF POSITIONING THRESHOLD IN RAYSTATION TREATMENT PLANNING FOR STEREOTACTIC TREATMENT

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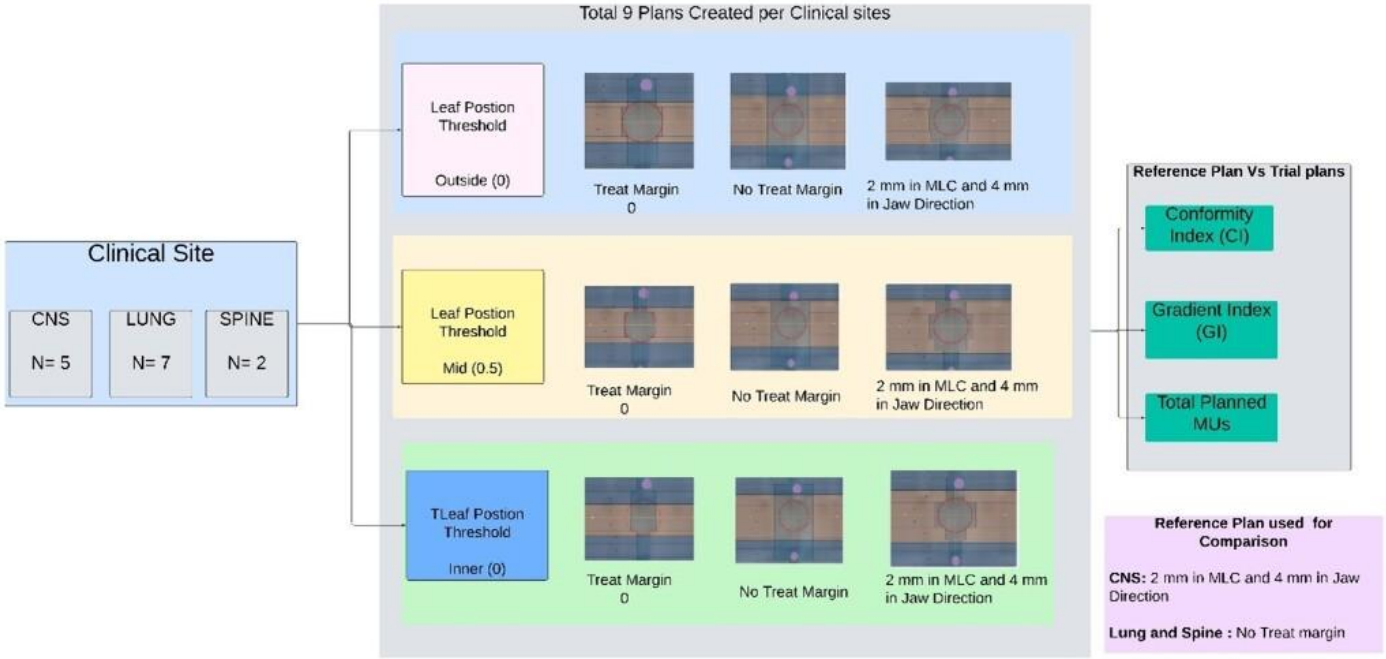
Introduction High dose conformity (CI) and steep dose gradients (GI) are essential for optimal stereotactic outcomes (1,2). While beam geometry and modulation are well-recognized factors, optimization parameters such as treatment margins and multileaf collimator (MLC) leaf positioning thresholds also play a significant role. This study investigates how variations in leaf positioning thresholds and treatment margins influence plan quality for both coplanar and non-coplanar stereotactic treatments, offering practical insights to guide planning strategies in Raystation treatment planning system.

Material and Method Previously treated stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT) cases were replanned using coplanar and non-coplanar VMAT techniques in RayStation (v2024A). Three MLC thresholds—Outside (0), Mid (0.5), and Inner (1)—and different treatment margins were
tested.



For each patient, nine plans were generated with 6 MV photons under identical optimization settings. Plan quality was assessed using CI, GI, and monitor units (MU) [3,4,5,6]. Statistical comparisons were performed to identify trends across thresholds and margin combinations.

Result CI showed minimal variation across thresholds, except for 'Inner (1)' with zero margin. GI varied by up to 20% for the same threshold depending on margin. The most favourable GI occurred with 'Outside (0)' and 'Mid (0.5)' thresholds at zero margin (Figure 2). MU was approximately 10% lower for 'Outside (0)' compared to 'Mid (0.5)' with zero margin, suggesting potential efficiency gains.

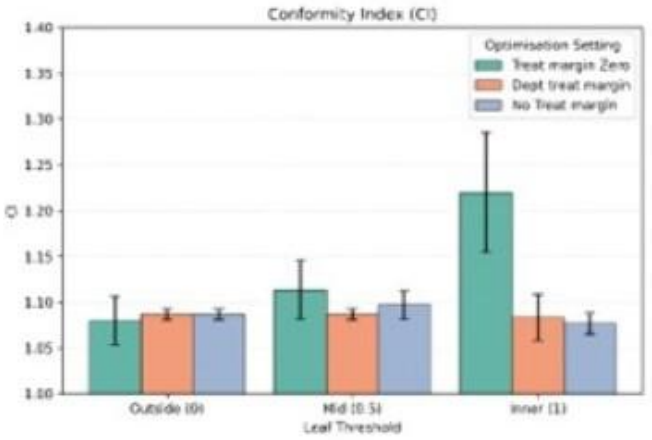


Fig 2a

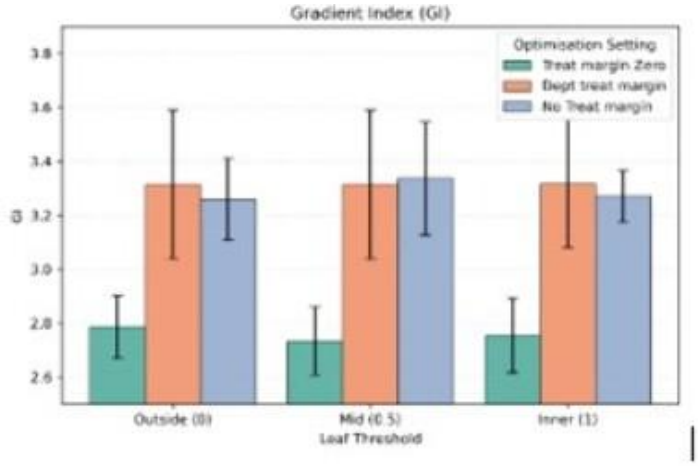


Fig 2b

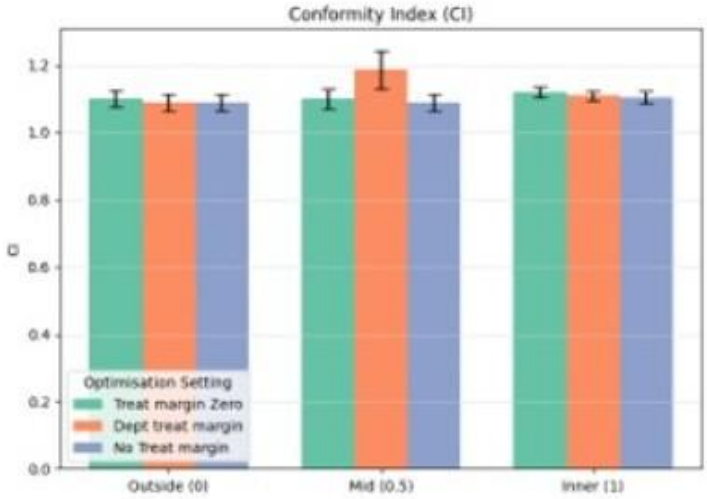


Fig 2c

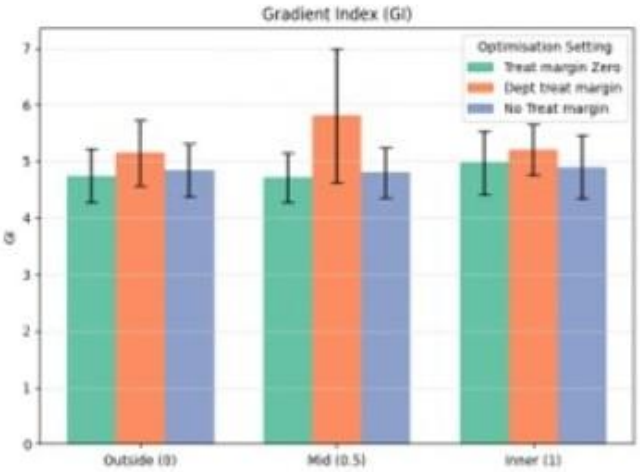


Fig 2d

Fig 2a, b: CI and GI comparison for crania SRS plans

Fig 2c, d: CI and GI comparison for SBRT plans

Conclusion The 'Outside (0)' leaf positioning threshold combined with zero margin achieved optimal GI and MU while maintaining CI for VMAT SRS and SBRT plans. These trends were consistent for both coplanar and non-coplanar techniques, suggesting that careful selection of optimization parameters can improve plan quality regardless of arc geometry. Further validation with larger datasets and deliverability checks is required before clinical adoption.

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PP-020

E-Poster Viewing
PHYSICS

HIGH-RESOLUTION DETECTOR–DERIVED DLG IMPROVES PATIENT-SPECIFIC QA FOR SRS AND SABR

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Purpose: To optimize dosimetric leaf gap (DLG) determination under small-field conditions using a high-resolution complementary metal–oxide–semiconductor (CMOS)–based stereotactic radiosurgery (SRS) detector and to evaluate the impact of applying the detector-derived DLG on patient-specific QA (PSQA) agreement for SRS and stereotactic ablative radiotherapy (SABR).

Methods: The SRS detector–based DLG (SRS-DLG) workflow was optimized using detector-specific output calibration, uniformity correction, and gantry-angle response correction. Angular correction factors were derived from sequential measurements over 0°–355°, with an additional patient-right (PR)–focused correction for plans with substantial PR-direction gantry arcs. SRS-DLG was derived from static fixed-gap fields (2–20 mm) using an integration-and-linear-fit approach. The fitting procedure was verified by applying the same workflow to TPS-generated dose maps calculated with a pre-specified manufacturer DLG. Nine SRS and ten SABR plans were recalculated in AcurosXB (v18.1) using manufacturer DLG versus SRS-DLG and compared with measured 2D dose maps using 1%/1 mm gamma analysis (global normalization, absolute dose, 10% threshold).

Results: Uniformity correction minimally affected 2%/1 mm results but increased the 1%/1 mm gamma passing rate (GPR) from 78.8% to 92.3% for a 10 × 10 cm^2 field. Angular correction factors were approximately symmetric about 180°, and the PR-focused correction further improved 1%/1 mm GPRs in PR-arc–dominant plans (e.g., 85.7%→91.1%). The fitted DLG from TPS-generated dose maps agreed with the pre-specified manufacturer DLG, whereas SRS-DLG differed from the manufacturer value by 11.2%. Using SRS-DLG significantly increased GPRs for both cohorts (paired t-test, $p < 0.001$), with mean increases of 1.74% (SRS) and 1.28% (SABR).

Conclusions: A detector-based DLG commissioning workflow enables robust small-field DLG determination. Implementing the commissioned detector-derived DLG improved PSQA agreement for SRS and SABR plans and reduced DLG-related TPS leaf-modeling bias, supporting more consistent stereotactic QA.

PP-021

E-Poster Viewing
PHYSICS

A NOVEL GUIDE INDICATOR FOR SRS PRECISION

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Background
Stereotactic radiosurgery (SRS) has become a well-established treatment modality for various intracranial vascular disorders, including arteriovenous malformations, owing to its high spatial accuracy and minimally invasive nature. Accurate target localization is a critical determinant of successful SRS outcomes, and angiography continues to play a central role in defining vascular anatomy during stereotactic treatment planning. However, conventional angiographic reference indicators may be associated with geometric inconsistencies, potentially affecting reproducibility and overall targeting precision.

Objective
In this study, we propose a novel angiography-based guide indicator designed to improve the precision and consistency of stereotactic angiographic imaging used in the SRS workflow. Methods
The newly developed indicator incorporates a modified geometric configuration in which the intersections of predefined “+” and “×” reference markers are aligned, and a fixed guideline wire connects these reference points to provide a stable and reproducible spatial reference. This design aims to reduce positional variability and enhance the reliability of angiographic localization across repeated image acquisitions.

Results
To evaluate the performance of the proposed guide indicator, stereotactic angiographic images were acquired repeatedly in both anterior–posterior and lateral projections using conventional indicators and the newly developed indicator. Quantitative analyses were performed by measuring deviations of predefined landmarks across repeated acquisitions. The results demonstrated that the novel guide indicator achieved improved spatial consistency, as evidenced by reduced mean deviations and smaller standard deviations compared with conventional angiographic indicators. These improvements were observed consistently in both imaging projections, indicating enhanced reproducibility of stereotactic alignment.

Conclusion
The findings of this study suggest that the proposed angiography guide indicator may provide a practical and effective means of improving stereotactic accuracy during angiography-based SRS planning for vascular disorders. By enhancing geometric consistency and reducing localization variability, this indicator has the potential to support more reliable treatment planning and execution.

PP-022

E-Poster Viewing
PHYSICS

CHANGES IN RADIATION DOSE DISTRIBUTION ACCORDING TO PHANTOM MOVEMENT IN THE GAMMA KNIFE ICON

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Purpose: This study aimed to investigate changes in radiation dose distribution in the Gamma Knife Icon according to patient movement when using a mask.

Materials and Methods: A phantom was subjected to one-dimensional motion, and a film was installed to measure radiation dose distribution in two-dimensional images. The phantom's motion was controlled using a linear motion device capable of controlling movement up to 0.005 mm. The position was controlled using an Arduino microcontroller. The phantom's motion was measured using an IR camera and High Definition Motion Monitoring (HDMM). Fiducial marks were observed by conducting a 4 mm shot of radiation before the phantom's movement on both sides of the film. The experiment was performed while the same amount of radiation was being administered, and the phantom's motion was simplified to move at a constant speed. The phantom's motion was set to 0.0, 0.5, 1.0, 1.5, and 2.0 mm, with 0.0 mm used as the base. The displacement was determined by subtracting the base film from the film at each distance.

Results: Since the edges of these distances were 0.0 to Deviation, the expected average displacement was 0.50 => 0.25, 1.00 => 0.50, 1.50 => 0.75, 2.00 => 1.00 (mm). When the phantom moved 0.5, 1.0, 1.5, and 2.0 mm, the pattern of radiation dose changes was similar, with the height of overdose and underdose almost proportional to the displacement. Analysis of log data from HDMM measuring the position of the nose showed only parallel motion of the phantom.

Conclusions: We found that the shape of the radiation dose distribution in the butterfly pattern occurred when the phantom moved in one direction, and that the displacement magnitude was reflected in the height of overdose and underdose. Further discussion is needed regarding three-dimensional motion in the future.

PP-023

E-Poster Viewing
PHYSICS

A QA DEVICE FOR CHECKING THE GATING FUNCTION OF GAMMA KNIFE'S HDMM SYSTEM

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We introduce an innovative QA device that we specifically invented for checking the gating function of Gamma Knife's HDMM system in mask-based Gamma Knife radiosurgery. Gamma Knife's High-Definition Motion Management (HDMM) system is a key device in the Gamma Knife radiosurgery system, which is used to monitor patient's motion and automatically manage the radiation beam to be on and off (gating) during mask-based Gamma Knife radiosurgery. When patient's motion exceeds the preset tolerance window, the radiation beam is automatically shut off while the patient swings back within the tolerance window and radiation beam is automatically resumed. The HDMM system has a manufacturer built-in feature - in either of the following circumstances the Gamma Knife unit will automatically pause the treatment, and the couch will move out to home position outside the shielding door for the treatment team to check the patient's position: (1) at the sixth time the patient deviates from the treatment position and beyond the tolerance, or (2) if the patient has deviated beyond the tolerance from the treatment position continuously for more than about 30 seconds. Performing routine Quality Assurance (QA) checks on the gating function of the HDMM system is crucial for the success of the treatment, and it is also a regulation requirement. Currently there is not a QA device available in the market, nor a user-friendly method or device provided by the manufacturer (Elekta Leksell Gamma Knife) to perform this QA task. We invented and fabricated an innovative QA device dedicated to this task. The device has been used for about 4 years in our Gamma Knife routine QA checks. Our experience indicates that the performance of this user-friendly device is excellent and it is worth commercialization and recommendation to the Gamma Knife community.

PP-024

E-Poster Viewing
PHYSICS

CHANGES IN PATIENT MARKER COORDINATES WITH HIGH-DEFINITION MOTION MANAGEMENT SYSTEM DURING FRAMELESS GAMMA KNIFE RADIOSURGERY

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The Leksell Gamma Knife (LGK) Icon™ facilitates frameless (mask-based) fixation through its high-definition motion management (HDMM) system. However, the HDMM only records the intra-fractional motion values of patient marker without specifying changes along the X, Y, and Z axes. This study investigates the coordinate shifts in patient markers using the HDMM system during frameless gamma knife radiosurgery (GKRS) in patients with meningioma and metastases. We conducted a retrospective study of patients diagnosed with meningioma or metastases who underwent frameless GKRS using the LGK Icon™ . All patients were immobilized using a Nanor thermoplastic mask for frameless fixation. Sequential data of the patients' nose marker coordinates were imported into the LGK system, and subsequent coordinate changes were analyzed. We evaluated patients with meningiomas (n=30) and metastases (n=30) who underwent GKRS with frameless fixation. None of the patients exhibited cognitive impairment or compliance issues. The median beam-on time was 44.2 minutes in patients with meningioma and 93.75 minutes in patients with metastases. In patients with meningioma, no significant intra-fractional displacements were found along the X (0.07±0.06 mm), Y (0.08±0.46 mm), and Z (0.08±0.04 mm) axes. However, in patients with metastases, the Y axis (0.57±0.37 mm, $p<0.05$) exhibited significantly greater intra-fractional displacements compared with the X axis (0.33±0.23 mm). No significant differences in intra-fractional displacement were observed between the X and Z (0.43±0.31 mm) axes or between the Y and Z axes. An analysis of movement over time revealed a significant increase in Y axis displacement after 30 minutes. Y axis movement, as indicated by the HDMM, was most prominent in patients with metastases. We recommend pressing the forehead when securing a mask to minimize nose marker movement. Additionally, when creating treatment plans for managing patients with metastases using the LGK Icon™, we suggest adding a 0.5 mm margin to the Y axis.

PP-025

E-Poster Viewing
PHYSICS

REDUCING TREATMENT TIME IN SINGLE-TARGET STEREOTACTIC RADIOSURGERY WITH VARIAN IDENTIFY

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Purpose Motion management is crucial in stereotactic radiosurgery (SRS). In our SRS program, patients are currently aligned for treatment using cone beam computed tomography (CBCT) imaging before each treatment field, which prolongs overall treatment times. Identify (Varian Medical Systems, Palo Alto) is an optical surface guidance system. We evaluated the integration of Identify into our SRS workflow with the aim of decreasing CBCT usage and overall improving treatment delivery efficiency.

Methods Identify- and CBCT-reported shifts were recorded for 18 SRS patients. A total of 38 treatment fields were included. The differences between the Identify- and CBCT-reported translational and rotational shifts were calculated for each treatment field, including intra-fraction and post-fraction imaging. Identify shifts were captured both manually and by recording timeseries data.

Results The mean and standard deviations of the differences are: lateral = 0.0 ± 0.3 mm, longitudinal = 0.1 ± 0.4 mm, vertical = 0.0 ± 0.3 mm, rotation = 0.0 ± 0.3°, pitch = 0.0 ± 0.3°, and roll = 0.0 ± 0.2°. These data are complemented by our commissioning data, which generally showed the Identify system to be accurate to tenths of a mm and tenths of a degree. For single-target SRS patients, we require an additional CBCT if any discrepancy between the planning CT and CBCT exceeds 1 mm or 1°. The time spent on re-imaging can range from 15 to 25 minutes per treatment. Based on the good agreement between Identify and CBCT imaging, we have eliminated CBCT imaging between arcs for single-target SRS patients.

Conclusions Identify-based surface guidance measurements in SRS treatments align closely with CBCT-based measurements. This has enabled a reduction in the number of CBCT images during SRS treatments involving a single target, benefiting these patients through a reduction in imaging dose and faster treatment times.

PP-026

E-Poster Viewing
PHYSICS

MACHINE LEARNING APPROACH FOR PRE-PLANNING 12-GY ISODOSE VOLUME PREDICTION IN BRAIN STEREOTACTIC RADIOSURGERY (SRS) BASED ON TARGET AND PLAN PARAMETERS AS PREDICTORS ON RADIXACT TOMOTHERAPY.

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Purpose:
The 12-Gy isodose volume ($V12_{Gy}$) is a well-established predictor of radiation-induced toxicity in brain stereotactic radiosurgery (SRS). Early estimation of $V12_{Gy}$ (cc) can contribute to safer treatment planning and guide prescription decisions. This study aims to develop and evaluate a Random Forest-based predictive model for $V12_{Gy}$ (cc) using target and plan-related parameters.

Methods:
The retrospective 35 brain SRS treatments undergone on helical tomotherapy were selected and planned optimally for different prescription doses and Pitch value on Accuray PrecisionTPS. For each case, the PTV volume, sphericity, spatial location, degree of OAR overlap, and prescription dose , Pitch value were quantified. A Random Forest regression model was trained to predict the $V12_{Gy}$ (cc) from above parameters, and feature importance scores were extracted to assess the relative contribution of each variable. Model performance was evaluated using 5-fold cross-validation, mean absolute error, and coefficient of determination (R^2).

Results:
The Random Forest model demonstrated remarkable predictive capabilities, accurately estimating $V12_{Gy}$ across various lesion types and locations. PTV volume emerged as the most significant predictor, followed by prescription dose, PTV sphericity, and OAR overlap. Notably, lesions with the same PTV volume and prescription dose but different in sphericity exhibited varying $_{V12Gy}$ volumes. Lower sphericity was associated with larger $V12_{Gy}$ values. The ensemble approach effectively captured the nonlinear interactions between geometric and dosimetric factors that influence $V12_{Gy}$. The R^2 value for the selected model was 0.9785 and MAE 5.7 cc

Conclusion:
This tool has the potential to enhance pre-planning risk assessment, support personalized prescription strategies, and improve the overall safety of SRS treatments.

PP-027

E-Poster Viewing
PHYSICS

G-FRAME VS VANTAGE: MRI DISTORTIONS IN STEREOTACTIC RADIOSURGERY

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Introduction Accurate MRI with minimal distortion effect is essential for the stereotactic radiosurgery, where frame-related artifacts can affect visualization and targeting precision. The Leksell G-Frame has long been the standard, but its metallic components introduce distortions across MRI sequences. The newer Leksell Vantage frame, although also associated with geometric uncertainties, features a non-metallic design intended to improve image quality. This study compares MRI performance between the G-Frame and Vantage systems to evaluate image distortions introduced by each fixation method.

Materials and Methods An anthropomorphic head phantom (CIRS 603A, Sun Nuclear) was scanned using two MRI systems: Siemens MAGNETOM Avanto 1.5 T and Siemens MAGNETOM Skyra 3 T, with a Multi-Planar Reconstruction sequence, 1 mm slice thickness. All data were analyzed either manually in Leksell GammaPlan and/or using DistortionCHECK™ software (Sun Nuclear). Cone-beam CT acquired via the CBCT arm of the Leksell Gamma Knife Icon served as the reference image for each frame fixation. CBCT was also verified and compared with CT imaging.

Results Image distortions were quantified both with and without fiducial-based stereotactic definition. Fiducial-related distortions were assessed using Leksell GammaPlan, which determines coordinates from frame-based fiducials, while DistortionCHECK™ evaluates distortions using a grid referenced to the phantom's central coordinate system. Using GammaPlan, mean distortions on the Avanto 1.5 T were 0.9 mm (G-Frame) and 0.7 mm (Vantage), and on the Skyra 3 T, 1.1 mm and 0.9 mm, respectively. Distortions excluding fiducials, measured by DistortionCHECK™, were slightly lower: 0.7 mm (G-frame) and 0.5 mm (Vantage) for the Avanto, and for the Skyra 0.8 mm and 0.6 mm.

Conclusion The Vantage frame demonstrates improved MRI image quality and reduced distortions compared to the G-Frame for both 1.5 T and 3 T systems, confirming its advantage for stereotactic procedures requiring high-precision imaging. Especially in higher magnetic field one can expect benefit of the Vantage.

PP-028

E-Poster Viewing
PHYSICS

RADIOSURGERY FOR MULTIPLE BRAIN METASTASES: IS LESION COUNT NO LONGER THE LIMITING FACTOR IN RADIOSURGERY?

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Background Advances in imaging, delivery, and planning optimisation have expanded the role of stereotactic radiosurgery (SRS) for patients with multiple brain metastases. Historically, lesion count limited eligibility due to concerns about normal brain dose and treatment practicality. Gamma Knife radiosurgery, with steep dose gradients and no planning target volume (PTV) margins, enables treatment of numerous metastases while maintaining acceptable V12 and total irradiated brain volume. This study evaluates the evolution toward higher lesion counts and examines associated dosimetric parameters relevant to toxicity.

Methods Patients treated over two time periods (2012–2019 and 2020–2024) at our institution were compared to assess trends associated with contemporary planning tools and workflows. A detailed dosimetric analysis was performed in a representative cohort of 120 patients, divided into three groups based on lesion count (1–5, 5–15 and ≥16 targets). Total tumour volume, V12 and normal brain dose exposure were evaluated to determine whether treating higher lesion numbers resulted in increased normal tissue irradiation.

Results The mean number of lesions treated per session increased from 4.3 (max 48) to 5.9 (max 54) between eras. Despite treating more lesions, mean total tumour volume per session remained below 4 cc across all three lesion-count groups (2.31 cc vs 3.75 cc vs 2.51 cc), and mean V12 minus total tumour volume remained below 13 cc (3.52 cc vs 7.48 cc vs 12.88 cc). Although total brain V12 sometimes exceeded the commonly referenced <10 cc threshold, this represented composite whole-brain dose. When partitioned by anatomical region, V12 values remained within accepted limits, supporting the safety of treating multiple metastases using modern Gamma Knife workflows.

Conclusion Modern Gamma Knife workflows safely and efficiently treat patients with many brain metastases. Dosimetric risk correlates primarily with total tumour volume rather than lesion count, supporting the evolving paradigm that high-lesion-count SRS is feasible and appropriate.

PP-029

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

ASSESSMENT OF MRI GEOMETRIC ACCURACY IN STEREOTACTIC RADIOSURGERY USING AUTOMATED DISTORTION ANALYSIS: A SINGLE-CENTER EXPERIENCE

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Introduction: Stereotactic radiosurgery (SRS) requires exceptional spatial accuracy due to the delivery of a high radiation dose in a single session. Thus, any geometric distortion of the magnetic resonance images (MRI) directly leads to an error in dose delivery. In our department, MRI distortion assessment is performed using the Elekta phantom, but in the absence of dedicated evaluation software, the procedure remains time-consuming and largely subjective. In this study, we are implementing original software "**ScanCheckup**" for standardized evaluation of the geometric accuracy of MRI scanners in a clinical center.

Materials and Methods: A single-center study was conducted using four 1.5T MRI scanners at the Burdenko Institute of Neurosurgery. A stereotactic phantom (Elekta) was scanned on each MRI scanner and additionally on a 16 slice CT scanner. Geometric distortions were assessed by quantifying the spatial deviations between the positions of the reference markers on the MR and CT image. Image registration and automatic calculation of displacement vectors for each marker were performed using the original software "ScanCheckup", developed at the National Research Nuclear University MEPhI.

Results: The analysis showed that the average spatial displacement on all tested MRI scanners remained below 0.35 mm. Maximal local distortions - reaching up to 2.75 mm - were systematically detected at the periphery of the visual field, while minimal displacements were observed at the image isocenter.

Conclusion: Geometric distortions were successfully evaluated using the in-house developed "ScanCheckup" software, which demonstrated that the geometric accuracy of the MRI scanners in our center is within clinical tolerances (average error < 0.35 mm). The "ScanCheckup" is essential for the routine quality control of MRI systems, ultimately improving safety and effectiveness of SRS by reducing the risks associated with spatial inaccuracies.

PP-030

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

AN MRI QUALITY ASSURANCE FRAMEWORK TO MINIMIZE LOCALIZATION ERROR IN STEREOTACTIC RADIOSURGERY

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Background:
High-precision stereotactic radiosurgery (SRS) requires MR images with minimal geometric distortion and consistent adherence to imaging protocols. Even sub-millimeter deviations can meaningfully alter dose delivery; for example, a 1 mm shift can reduce target dose by approximately 50%. To support reliable localization for Gamma Knife and linac-based SRS, our institution implemented a multi-component MRI QA program collaboratively maintained by Radiation Oncology and Diagnostic Imaging across a large, geographically distributed MRI fleet.

Methods:
The QA framework uses four integrated tools: (1) Modus QUASAR GRID 3D phantom for quantitative distortion mapping ; (2) MR Technologist guidance for Gamma Knife protocol defining acquisition requirements (i.e., >2 mm superior skull coverage, inclusion of face/nose, neutral head position, and minimal motion artifacts); (3) an automated protocol-monitoring dashboard that extracts key DICOM fields and flags deviations in bandwidth, FOV, orientation, and sequence parameters; and (4) daily scanner-status email reports to regularly communicate which scanners are cleared for SRS protocols.

Results:
More than 80 phantom measurements per year enable precise monitoring of geometric accuracy and trending of distortion metrics. For frameless SRS, current tolerances require mean absolute distortion ≤0.6 mm and <5% of grid points exceeding 0.8 mm. Outlier detection successfully identified scanners with transient degradation. Framed exams use relaxed thresholds due to a frame-related increase in geometric distortion.

Conclusion:
A coordinated MRI QA program combining phantom measurements, automated protocol verification, and structured image-quality criteria can meaningfully reduce MRI-induced localization error in SRS. This framework supports safe, reproducible SRS imaging across a distributed scanner fleet and may serve as a scalable model for other institutions.

PP-031

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

INTERNATIONAL SURVEY FOR INTRACRANIAL STEREOTACTIC RADIOSURGERY DOSIMETRY AUDITS – WHAT IS AVAILABLE WORLDWIDE AND HOW IT WORKS

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Introduction and Objectives: End-to-end dosimetry audits should be a mandatory part of good clinical practice in SRS. It should be performed ideally after acceptance and commissioning before the first treatment and repeated periodically. Unfortunately, clinical practice shows less than 30% of sites with SRS undergo dosimetry audits carried by a standards laboratory. The purpose of this project is to explore global audit availability in SRS and compare the available services.

Methods and materials: Currently, we identified institutions which offer intracranial SRS dosimetry audit: 1) The MD Anderson Dosimetry Laboratory (MDADL), Houston, USA, 2) National Radiation Protection Institute (NRPI), Prague, Czech Republic, 3) RTsafe P.C., Athens, Greece, 4) National Physical Laboratory, Teddington, UK, 5) Australian Clinical Dosimetry Service, Sydney, Australia. Two audits were performed so far: 1) NRPI audit provided measurement of mean dose in two points by Exradin W1 plastic scintillator detector and 2D dose distribution measured by Gafchromic EBT3 film in an adapted Alderson Head phantom, 2) MDADL audit provided point dose measurement by two TLDs and 2D dose distribution by two Gafchromic films. Both audits were performed on an identical Leksell gamma knife Icon unit. Deviation in mean point dose in two positions in the NRPI phantom was -2.9% and -0.7%, respectively. Gamma passing rate for absolute dose distribution measured by film was 99.1% (4 %/3 mm) and 98.5% (3% / 3 mm). Deviation in mean dose measured by two TLD capsules in the MDADL phantom was 0.45% and -0.04%, respectively. Gamma passing rate for absolute dose distribution measured by two films was 100% and 99% for (5%/3 mm).

Conclusion: End-to-end tests showed good agreement between planned and delivered dose for both absolute point dose and 2D dose distributions from both audits. As the study progresses we expect to perform audits from all providers.

PP-032

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

FROM IMPROVISED PHANTOMS TO 3D COMMERCIAL VERIFICATION: LESSONS LEARNED IN MRI DISTORTION ASSESSMENT FOR VANTAGE-BASED RADIOSURGERY

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Background High geometric MRI accuracy is essential for stereotactic localisation in Gamma Knife radiosurgery. When commissioning the Vantage workflow, no suitable commercial distortion phantom was available, creating a challenge in verifying localisation accuracy. Our staged approach began with improvised methods, progressed to a clinical accuracy audit, and culminated in full three-dimensional verification using the first commercially available IBA distortion phantom.

Methods Initial commissioning was performed using the RTsafe PRIME phantom with an MRI geometric insert. Geometric accuracy was assessed using a clinical T1 sequence by evaluating fiducial localisation and comparing anatomical landmarks with reference CT/CBCT datasets. A prospective clinical audit in 72 Vantage frame patients assessed MRI fiducial error, MRI–CBCT co-registration quality, and maximum shot displacement (MSD). Following acquisition of the commercial IBA QUASAR™ Vantage Phantom containing 1,813 control points, volumetric distortion mapping across the stereotactic volume was performed under routine imaging conditions. The accompanying analysis software generated a distortion vector field and a report detailing x, y, z and radial distortion values with corresponding uncertainties for each control point.

Results MRI–CT comparison demonstrated mean distortion values of <1 mm across assessed T1 scan volumes. The clinical audit confirmed sub-millimetric stereotactic accuracy, with a mean MRI fiducial localisation error of 0.37 mm, over 70% of MRI–CBCT co-registrations rated as “Good,” and a mean MSD of 0.53 mm. All parameters remained within institutional tolerance and showed consistent performance across workflows. Verification with the IBA phantom demonstrated geometric distortion <1 mm throughout the clinically relevant stereotactic volume, validating both the initial commissioning methodology and subsequent clinical accuracy.

Conclusion MRI distortion evaluation remains essential for Gamma Knife radiosurgery. Improvised testing, when supported by structured clinical audit and final 3D phantom verification, provides robust assurance of stereotactic accuracy. Continued distortion monitoring is critical to maintaining safe and precise MRI-based Gamma Knife practice.

PP-033

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

A FULLY INTEGRATED QA AND DATA-MANAGEMENT PLATFORM FOR CYBERKNIFE STEREOTACTIC TREATMENTS

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Background:
Stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT) for brain and spinal lesions require rapid planning and delivery, often under tight deadlines. Manual quality assurance (QA) and data collection workflows can introduce delays and inconsistencies. Meanwhile, advanced analytics and artificial intelligence (AI) in radiation oncology demand high-quality, well-annotated clinical datasets. We developed an integrated software platform that automates SRS/SBRT plan QA, streamlines clinical workflow, and constructs a structured CyberKnife ®-specific treatment database.

Methods:
The custom software interfaces with the treatment-planning system, electronic medical record (EMR) and delivery record/verify systems to automate QA, reporting and data extraction. For each active plan, the system performs a set of site- and collimator-specific QA checks (deliverability, imaging adequacy, plan-quality metrics). Plans not yet approved trigger a planner-directed QA report; upon plan approval, the system generates a physicist second-check report. At plan approval, the system automatically archives DICOM files and plan parameters into the database. When the patient's treatment course is completed, delivered-treatment data (fractions delivered, tracking performance) are retrieved and linked with the plan record. End-of-treatment summaries are automatically generated and distributed to the treating physician.

Results:
Since deployment, the platform has ingested 132 CyberKnife plans and corresponding delivery data. It is fully integrated into clinical workflow and used routinely by all planners and treating physicians in our center. The automated QA engine has already detected multiple issues requiring replanning, including configuration inconsistencies and clinically meaningful quality/safety concerns. Estimated time savings are at least 20 minutes per case, with documented improvement in consistency of QA and reporting.

Conclusion:
This integrated QA and data-management platform enhances workflow efficiency and patient safety for CyberKnife SRS/SBRT, while establishing a robust clinical database to support future analytics and AI-based applications.

PP-034

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

DOSIMETRIC IMPACT OF AUTOMATIC COUCH ANGLE OPTIMIZATION IN STEREOTACTIC RADIOSURGERY FOR MULTIPLE BRAIN METASTASES

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Purpose In stereotactic radiosurgery (SRS) for multiple brain metastases, minimizing normal brain irradiation while maintaining high target conformity is essential to reduce treatment-related toxicity. Both high-dose volume and cumulative low-dose brain exposure have been associated with adverse effects, particularly in patients with multiple lesions. Automatic couch angle optimization has been introduced to improve beam geometry and potentially reduce unnecessary normal brain dose. This study evaluated its dosimetric impact compared with fixed couch angle planning.

Methods Fifteen patients with a total of 97 brain metastases were planned using Brainlab Elements Multiple Metastases with dynamic conformal arcs. For each patient, two plans were generated: one using 4-7 automatic couch angle optimization and one using 5 regular fixed couch angles. Paddick Conformity Index (PCI) was evaluated on a lesion basis and the influence of lesion volume was assessed. Normal brain exposure was evaluated on a patient basis using volumes of brain minus GTV receiving 12Gy (V12), 10Gy (V10), 5Gy (V5), 4Gy (V4), and 3Gy (V3). Paired t-tests and Wilcoxon signed-rank tests were used for statistical comparison.

Results No statistically significant difference in PCI was observed between optimized (0.71±0.1) and fixed couch angle plans (0.66±0.1), indicating equivalent target conformity. Lesion volume did not significantly influence PCI nor the difference between planning strategies. Similarly, no statistically significant differences were found between optimized and fixed plans for V12 (14.9±7.8cm^3 vs 14.6±7.6cm^3), V10 (22.4±11.6cm^3 vs 22.2±11.9cm^3), V5 (103.8±83.9cm^3 vs 106.6±89.4cm^3), V4 (174.7±151.2cm^3 vs 174.8±158.6cm^3), or V3 (319.8±265.4cm^3 vs 305.4±259.7cm^3). The number of treated lesions per patient was not associated with low-dose brain exposure or with differences between planning approaches.

Conclusion Automatic couch angle optimization did not significantly improve target conformity or normal brain dose compared with fixed couch angle planning. Lesion volume and lesion number did not modify these findings, suggesting no consistent dosimetric advantage.

PP-035

E-Poster Viewing
QUALITY ASSURANCE & DOSIMETRY

OPTIMIZING CONFORMITY AND NORMAL TISSUE SPARING IN MULTI-MET SRS: A LINAC–GAMMA KNIFE DOSIMETRIC COMPARISON

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Purpose: Linac-based single-isocenter (SIT) stereotactic radiosurgery (SRS) enables efficient treatment of multiple brain metastases but may compromise conformity and low-dose spillage. Dual-isocenter techniques (DIT) may overcome these limitations, while Gamma Knife (GK) remains the benchmark for SRS. This study compares SIT and DIT against GK, with particular attention to conformity and low-dose brain exposure.

Material and Methods: Fourteen patients with 4–10 brain metastases (81 lesions) were planned using GK and Brainlab Elements Multiple Brain Mets v4.0 using automated geometric optimization for SIT and DIT linac plans. Lesions were spatially clustered for DIT, assigning one isocenter per cluster. Plan quality was assessed using Paddick Conformity Index (PCI) per lesion and low-dose brain volumes 12Gy (V12), 10Gy (V10), 5Gy (V5), 4Gy (V4), and 3Gy (V3) per patient. Technique differences were tested using Friedman repeated-measures tests with Holm-adjusted paired Wilcoxon comparisons.

Results: GK achieved the highest PCI (0.82±0.15), followed by non-significant difference for DIT approach (0.74±0.13), while SIT showed significant lower conformity (0.70±0.12). Conformity with GK increased with lesion volume, whereas no clear volume dependence was observed for the linac-based techniques. GK consistently produced the lowest low-dose volumes. DIT planning reduced low-dose spread compared with SIT delivery, with the relative benefit increasing at lower dose levels (approximately 6% reduction at V12, rising to 17% at V3). Across techniques, low-dose volumes rose with total tumor burden, while very-low-dose exposure was additionally driven by lesion count with SIT.

Conclusion: DIT offers clear dosimetric benefits over SIT, with better target conformity and reduced low-dose spread. Compared with DIT, GK shows no major PCI advantage overall, though its benefit increases with lesion size and it remains superior for very-low-dose sparing. Overall, DIT is a clinically relevant balance between plan quality and efficiency, narrowing the gap with GK for suitably clustered metastases.

PP-036

E-Poster Viewing
RADIOBIOLOGY

ENHANCING RADIOTHERAPEUTIC EFFECTS VIA NANOPARTICLE-MEDIATED RADIOSENSITIZER DELIVERY GUIDED BY FOCUSED GAMMA RAYS IN LEWIS LUNG CARCINOMA–BEARING MOUSE BRAIN TUMOR MODELS

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Background: Targeting radiosensitizer-incorporated nanoparticles to tumors can reduce normal tissue toxicity and enable more efficient drug release, ultimately improving the efficacy and safety of radiation therapy. This study aimed to enhance tumor-specific delivery and bioavailability of a nanoparticle-mediated radiosensitizer in mouse brain tumor models.

Methods: A pH-sensitive nanoparticle, chitoPEGAcHIS, was conjugated with the recombinant peptide HVGGSSV, which binds to tax-interaction protein 1 (TIP-1), a radiation-inducible receptor. The c-Jun N-terminal kinase (JNK) inhibitor SP600125 was then incorporated into the copolymer to generate the HVGGSSV-chitoPEGAcHIS-SP600125 (HVSP-NP) nanoradiosensitizer. In vitro and in vivo radiation treatments were performed using a Gamma Knife system. Tumor targetability of HVSP-NP was assessed by optical bioluminescence imaging. Synergistic therapeutic effects of combining radiation therapy with HVSP-NP were evaluated in Lewis lung carcinoma (LLC) cell–derived mouse brain tumor models.

Results: The JNK inhibitor SP600125 effectively reduced DNA damage repair in irradiated LLC cells. The pH-sensitivity assay demonstrated that HVSP-NP swelled and increased in diameter under acidic conditions, leading to a gradual increase in the drug-release rate. Optical bioluminescence imaging confirmed radiation-induced TIP-1 expression in mouse brain tumors and selective accumulation of the nanoradiosensitizer in irradiated tumors. Radiation therapy combined with HVSP-NP induced greater apoptosis and significantly suppressed tumor growth compared with radiation alone.

Conclusion: HVSP-NP, a novel nanoradiosensitizer, selectively targeted irradiated tumors and substantially enhanced tumor growth delay in LLC-bearing mouse brain tumor models. These findings demonstrate that delivering a pH-responsive nanoradiosensitizer to brain tumors with radiation-induced TIP-1 expression can improve radiosensitizer release within the acidic tumor microenvironment and produce synergistic therapeutic effects when combined with radiation treatment.

PP-037

E-Poster Viewing
RADIOSURGERY PROGRAM DEVELOPMENT

IMPLEMENTATION OF RADIATION THERAPIST CREDENTIALLING TO SAFELY REDUCE RADIATION ONCOLOGIST ATTENDANCE IN STEREOTACTIC TREATMENT DELIVERY

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The delivery of Stereotactic Radiosurgery (SRS) and Stereotactic Body Radiation Therapy (SBRT) requires rigorous image guidance, high-level clinical decision-making, and structured governance to ensure safe delivery of high-dose, high-gradient treatments. Historically, our centre mandated Radiation Oncologist (RO) attendance for online image review at every stereotactic treatment fraction. With increasing stereotactic caseloads and expanding clinical indications, this approach became resource-intensive, prompting development of a more sustainable model that maintains safety while optimising workforce utilisation. We implemented a full-scale stereotactic treatment credentialling program for radiation therapists (RTs), specifically designed for SRS/SBRT online image-guided radiotherapy (IGRT). The program incorporates structured education, documented competency standards, site-specific assessments, supervised clinical practice, and formal demonstration of stereotactic imaging interpretation and decision-making proficiency. Since implementation in 2021, 14 RTs have been credentialled through this framework. To support this expanded capability, a risk-stratified decision model was introduced to determine when stereotactic treatments could be safely delivered by two credentialled RTs without RO presence. Eligibility is based on proximity to critical organs, motion uncertainty, fractionation, and site-specific risk criteria defined within departmental governance documents. RO attendance is reserved for higher-risk scenarios, with clearly defined escalation pathways requiring immediate RO consultation for changes in patient anatomy, inadequate image quality, or uncertainty in organ-at-risk visualisation. Mandatory offline RO image review and Senior Imaging RT oversight support continuity of care. Since 1 July 2024, 345 stereotactic patients have been treated under this model, with RO attendance required for the first fraction in 45 cases (13.0%). Consequently, 87.0% of patients commenced treatment without RO attendance, resulting in substantial reductions in RO time requirements and improved treatment slot flexibility. This integrated credentialling framework demonstrates a safe, scalable, and reproducible model for RT-led stereotactic IGRT delivery that has not previously been published in full and may be adopted to support sustainable SRS/SBRT service delivery.

PP-038

E-Poster Viewing
RADIOSURGERY PROGRAM DEVELOPMENT

THE IMPORTANCE OF MRI DISTORTION ROUTINE QA CHECK FOR STEREOTACTIC RADIOSURGERY – THE EXPERIENCE FROM DISTORTION MEASUREMENT ON MORE THAN 20 MRI SCANNERS OVER 10 CONSECUTIVE YEARS

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MRI images have been widely used for almost all treatment planning of radiosurgery, where they are used for delineating targets and organs at risk (OARs) during the treatment planning process owing to MRI's unique capability of identifying targets and OARs in soft tissues compared with using CT images. Unlike CT images, MRI images have a considerable magnitude of geometrical distortion due to the scanner-related inhomogeneities of magnet fields and the signal processing-dependent artifacts of MRI scanners. This distortion results in the deviation of the space points shown on an MRI image from their positions in reality, and the deviation leads to the discrepancy between the dose that is actually delivered and the dose calculated from the treatment planning process because the dose calculation is based on the coordinates of space points on MRI images. The severity of this discrepancy depends on the magnitude of the MRI distortion, and the potential impact to the treatment outcome is significant for treating the targets near critical structures, especially for small targets and the high-dose radiosurgery for brain function diseases such as trigeminal neuralgia, essential tremor, OCD, etc. Quantification of the magnitude of MRI distortion is crucial for the success of radiosurgery. Over the past 10 years we have been systematically performing quantified image distortion QA checks annually or whenever an MRI scanner has undergone a major upgrade using the commercial MRID3D phantom and Grid3D phantom on more than 20 MRI scanners of 1.5T or 3T of various major manufacturers across our medical center and the affiliated outpatient centers. The measurement results and the experience we have collected from this 10-year journey indicate the importance of routine MRI distortion QA checks for Gamma Knife and Linac-based stereotactic radiosurgery, which is worth sharing with the ISRS community.

PP-039

E-Poster Viewing
RADIOSURGERY PROGRAM DEVELOPMENT

INTERINSTITUTIONAL COLLABORATION TO DELIVER NEUROAXIS RADIOTHERAPY AND STEREOTACTIC RADIOSURGERY FOR BRAIN METASTASES IN MEXICO: EXPERIENCE FROM TWO NATIONAL REFERENCE CENTERS

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BACKGROUND: In middle-income settings, access to stereotactic radiosurgery (SRS) and neuroaxis chemoradiotherapy may be limited when central nervous system (CNS) care and molecular diagnostics are distributed across separate reference centers. We implemented a bidirectional pathway between the Instituto Nacional de Neurologia y Neurocirugia (INNN) and the Instituto Nacional de Cancerologia (INCan) to deliver intracranial SRS for brain metastases, coordinate neuroaxis radiotherapy/chemotherapy with molecular pathology for malignant primary CNS tumors, and support commissioning and start-up of intracranial SRS at INCan.

METHODS: Retrospective descriptive review of consecutive patients managed from March 2024 to the present. The collaboration was enabled by shared human resources and harmonized clinical/physics workflows across institutions.

RESULTS: In the INCan-to-INNN pathway, 66 patients were referred for SRS at INNN for 156 intracranial metastases. Age range was 30-78 years (median 53); 57.1% were female. Median cumulative intracranial tumor volume was 3.10 cm^3 (interquartile range [IQR] 1.39-6.90; range 0.1-105.6). Primary sites were lung (42.9%), breast (28.6%), and kidney (11.4%), with other primaries less frequent; 62.9% originated from Mexico City/State of Mexico. In parallel, intracranial SRS was initiated at INCan and, through November 2025, 18 intracranial patients with brain metastases were treated (7 lung, 6 breast, and the remainder from gynecologic, colorectal, and sarcoma primaries). Additionally, 20 malignant primary central nervous system (CNS) tumor patients were referred from INNN to INCan for neuroaxis radiotherapy/systemic therapy: 13 medulloblastomas, 1 ependymoma, 2 choroid plexus carcinomas, 2 embryonal tumors (BCOR [BCL6 corepressor]-altered and embryonal tumor with multilayered rosettes), 1 grade 3 1p/19q-codeleted oligodendroglioma with leptomeningeal dissemination, and 1 primary CNS germinoma.

CONCLUSIONS: A collaboration between national neurologic and oncologic reference centers was feasible, expanded access to intracranial SRS, enabled cancer-center SRS start-up, and facilitated

complex neuroaxis care. This framework may be scalable for capacity building and equitable access to SRS in resource-constrained health systems.

PP-040

E-Poster Viewing
RADIOSURGERY PROGRAM DEVELOPMENT

TWO DECADES OF STEREOTACTIC RADIOSURGERY AND RADIOTHERAPY AT A NATIONAL REFERRAL CENTER: A 6 831-PROCEDURE EXPERIENCE FROM MEXICO (2003–2025)

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Purpose: Long-term institutional data describing stereotactic radiosurgery (SRS) and stereotactic radiotherapy (SRT) practice in Latin America remain scarce. We report 22 years of stereotactic radiation activity at the National Institute of Neurology and Neurosurgery (INNN), a national referral center in Mexico.

Methods: We retrospectively analyzed a prospectively maintained registry of stereotactic radiation procedures performed from October 2003 through August 2025. Diagnoses were harmonized into contemporary categories. Treatments were classified as single-fraction SRS (SRS), hypofractionated stereotactic RT (2–5 fractions; hFSRT), or conventional fractionated RT (>5 fractions; FSRT). Descriptive statistics and temporal trends were summarized.

Results: The median patient age was 45 years (IQR 33–56), and women constituted 56 % of the cohort. Approximately 60 % of patients were referred from outside Mexico City, highlighting the INNN's national role. The most common diagnoses were meningioma (18 %), pituitary adenoma (16 %), diffuse glial or glioneuronal tumors excluding glioblastoma (15 %), brain metastases (10 %), vestibular schwannoma (9 %) and glioblastoma (9 %). Overall, 52.9 % of procedures used conventional radiotherapy, 49.5 % single-fraction SRS and 4.7 % hypofractionated SRS. Median ages varied by pathology: vascular malformations presented at 28 years, whereas metastases and glioblastoma occurred in the sixth decade. Meningiomas and pituitary adenomas showed nearly equal use of SRS and conventional RT, whereas diffuse gliomas and glioblastomas were predominantly treated with conventional RT.

Conclusions: This 22-year single-institution series is among the largest of its kind in Latin America. It demonstrates that SRS and SRT are used in nearly equal proportions, with modality selection strongly influenced by diagnosis and lesion characteristics. The findings underscore the importance of continuing to integrate technological advances and molecular tumor classifications while establishing systematic outcome tracking to optimize patient care and inform future clinical trials

PP-041

E-Poster Viewing
SBRT – BREAST

FIVE FRACTIONS SCHEDULE RADIOTHERAPY FOR EARLY BREAST CANCER WITH SIMULTANEOUS INTERGRADED BOOST. OUR 5 YEARS SINGLE-INSTITUTION EXPERIENCE.

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Background:
This study reports the clinical experience of an ultra-hypofractionated radiotherapy regimen for early breast cancer, consisting of **26 Gy in five fractions** to the whole breast with a **simultaneous integrated boost (SIB) of 29 Gy in five fractions** to the tumor bed. The aim was to evaluate safety, toxicity, and patient convenience of this one-week schedule.

Methods:
Between November 2020 and December 2025, **65 patients** aged 40–70 years with early-stage invasive breast carcinoma (T1–2, pN0, M0) treated with breast-conserving surgery were enrolled. All patients met the eligibility criteria of the **FAST-Forward trial**. During surgery, two pairs of titanium clips were placed to ensure accurate tumor bed delineation. CTVs were expanded to create **PTVwb** with a 10-mm margin and **PTVTB** with a 5-mm margin. Organs at risk included ipsilateral lung, heart, contralateral breast, and ipsilateral ribs. Treatment was delivered using **VMAT with 6 MV beams**, ensuring highly conformal dose distributions. Daily verification with **CBCT** and 6-degree-of-freedom couch corrections was performed. Baseline ultrasound and photographic documentation were recorded. Patients were evaluated at week 1, week 4, and every 3 months thereafter.

Results:
All 65 patients completed the planned five-fraction regimen. Dose coverage targets were consistently achieved, with **V95% > 95%** for both whole-breast and boost volumes. All organs-at-risk met the **FAST-Forward trial** dose constraints. After a follow-up of **6 months to 4 years**, no clinically meaningful changes in breast appearance or contour were observed. Acute skin toxicity, graded **≤2** in all patients, with no unexpected adverse reactions.

Conclusions:
Ultra-hypofractionated whole-breast irradiation of **26 Gy in 5 fractions** with an integrated boost to **29 Gy** is a **safe, well-tolerated, and highly time-efficient** approach for early breast cancer. It provides excellent dosimetric coverage, low toxicity, and preserved cosmetic outcomes, offering a practical one-week alternative without compromising treatment quality or safety.

PP-042

E-Poster Viewing
SBRT – GENITO-URINARY

SBRT FOR LOCALIZED PROSTATE CANCER USING THE RAYPILOT SYSTEM WITH MODIFIED FOLEY CATHETER BASED ON HYPOCATH SYSTEM PERMITTING A REAL-TIME INTRAFRACTION TRACKING PROSTATE MOTION. OUR TWO YEARS SINGLE INSTITUTION EXPERIENCE.

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Background The UK PACE trials confirmed that 5-fraction SBRT is non-inferior to conventional fractionation for men with prostate cancer. PACE-B demonstrated no significant difference in acute GU and GI toxicity between 36.25 Gy in 5 fractions versus 62 Gy in 20 fractions at 12 weeks post completion of radiotherapy. The PRECISION study further explored 3-fraction ultra-hypofractionation by using the Raypilot system.

Materials and Methods The RayPilot system enables real-time urethra tracking during linac-based SBRT delivery, potentially reducing acute toxicity through urethra-sparing. A HypoCath which consists of a modified Foley catheter with an embedded transmitter is positioned within the prostatic urethra. The catheter is clearly visible on planning CT and treatment CBCT. Continuous tracking (1Hz frequency) provides precise urethral localization throughout delivery, enabling dose reduction to the urethral PRV to minimize GU toxicity, reduced CTV-PTV margins (3mm uniformly, 2mm posteriorly) while maintaining geometric accuracy, and immediate detection of target displacement beyond 2mm tolerance, triggering beam interruption and position correction.

Results 17 patients (PSA ≤10 ng/ml, Gleason Score ≤7, T2N0M0, IPSS <12) underwent 3-fraction SBRT (prostate ± proximal SV) within 3 years (08/22-08/25), delivering 31.5 Gy to CTV and 28.5 Gy to PTV using the RayPilot system. Treatment employed HypoCath tracking with daily CBCT verification and 2mm intervention threshold. Mean treatment time was 10 minutes per fraction using 6MV FFF VMAT. Real-time tracking (38287 counts) demonstrated geometric stability with 2.78% lateral, 3.72% longitudinal, and 8.51% vertical displacements exceeding the 2mm threshold, requiring beam interruption and position correction. At median 18-month follow-up, no SBRT-related GU or GI toxicity (>2grade) occurred. The HypoCath system was well tolerated.

Conclusions Prostate SBRT using RayPilot/HypoCath tracking is safe and well-tolerated, permitting a urethra-sparing approach that minimizes GU side effects.

PP-043

E-Poster Viewing
SBRT – GENITO-URINARY

EMPIRICAL VALIDATION OF A 3MM GEOMETRIC MARGIN AND ANATOMICAL PREDICTORS OF INTRAFRACTION MOTION IN PROSTATE SBRT USING REAL-TIME TRACKING

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PURPOSE: To validate the geometric adequacy of a 3mm CTV-PTV margin for ultra-hypofractionated prostate SBRT (The Precision Study) using real-time tracking and determine anatomical predictors of intrafraction motion. This study also investigates how rectal and bladder variability affects electromagnetic transmitter displacement anchored in the prostatic urethra. Since conventional margin formulas (e.g., Van Herk) underestimate requirements for hypofractionated regimens (N=3), validation was performed empirically combining daily CBCT with real-time tracking.

METHODS: Fifteen patients underwent 3-fraction prostate SBRT (45 fractions) with real-time tracking (RayPilot) using 2mm action threshold. Interfraction errors were quantified from CBCT shifts while intrafraction motion characterized from tracking data. Margin adequacy was validated by calculating percentage of time geometric displacement remained <3mm. The impact of rectal gas presence, rectal and bladder volumes were analyzed using Welch's t-tests and Pearson correlations.

RESULTS: Interfraction systematic errors (Σ_inter: 1.1-2.2mm) significantly exceeded intrafraction errors (Σ_intra: 0.3-0.4mm). With 2mm threshold, the 95th percentile was 2.5mm (lateral), 2.8mm (longitudinal), and 3.0mm (vertical), confirming 3mm margin sufficiency. Lateral motion increased significantly with rectal gas (2.0mm vs 0.9mm, $p=0.048$) and rectal volume ($r=0.64$, $p<0.001$) while there was no significant correlation with bladder volume.

CONCLUSIONS: This study empirically validates that 3mm CTV-PTV margin provides adequate geometric coverage for prostate SBRT with intrafraction 2mm action threshold. While rectal gas drives lateral motion, real-time tracking effectively manages these excursions. Intrafraction monitoring is essential for maintaining geometric accuracy required to support reduced PTV margins in hypofractionated regimens. Smaller margins with tighter thresholds can be further investigated.

PP-044

E-Poster Viewing
SBRT – HEAD AND NECK

HYPOFRACTIONATED STEREOTACTIC RADIOTHERAPY FOR ORBITAL METASTASES: FEASIBILITY, EARLY OUTCOMES, AND PALLIATIVE EFFECTS

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Introduction: Orbital metastases are relatively uncommon, usually resulting from primary breast cancer (36.3%) and can cause significant symptoms. Patients often suffer with proptosis, relative afferent pupillary defect and diplopia of the affected eye, leading to pain and reduced quality of life. Treatment of orbital metastases include surgical resection, radiotherapy or chemotherapy, depending on patient condition (1).

Materials and methods: Eleven patients were initially indicated for stereotactic radiotherapy (SRT) for orbital metastases (median age 58 years; 2 men, 9 women), with primary tumors from the breast, lung, melanoma, and kidney. Stereotactic treatments were performed using linear accelerator Varian EDGE and CyberKnife. One patient underwent surgical resection, and two were excluded due to rapid intracranial progression before simulation. Eight patients received SRT, with a median GTVa volume of 14.17 cc (range 1.59–43.7 cc). Treatment was delivered in 1–10 fractions, most commonly 25–30 Gy in 5 fractions (2), including single-session radiosurgery (31.25 Gy/1 fraction) and 30 Gy/10 fractions. Two patients had not yet reached the first 3-month follow-up MRI.

Results: Radiologic response was evaluable in six patients. Among evaluable patients, partial response (PR) was observed in five, and complete response (CR) in one patient. Edema reduction and significant clinical improvement were noted in all patients, including reductions in proptosis, diplopia, and patients reported an overall better subjective well-being. One patient had lost vision prior to treatment, which did not recover afterward. No high-grade toxicity (CTCAE ≥3) was observed.

Conclusions: Orbital metastases pose a problem due to late diagnosis, significant symptoms that affect quality of life, and limited local treatment options. However, modern radiotherapy allows for rapid, precise, and safe treatment. Stereotactic radiotherapy offers an effective approach to control local disease, alleviate symptoms, and preserve vision.

References:
1. Palmisciano et al. (2021b)
2. Milano et al. (2018)

PP-045

E-Poster Viewing
SBRT – HEAD AND NECK

IMPLEMENTATION OF STEREOTACTIC BODY RADIOTHERAPY (SBRT) FOR HEAD AND NECK CANCER (HNC)

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Introduction: Locoregional relapse in previously irradiated patients with HNC poses significant challenges in treatment planning. Although surgery is the preferred option for post-radiotherapy recurrence, re-irradiation is beneficial for those who are unsuitable for surgery. SBRT offers the advantage of delivering conformal and precise ablative radiation doses in fewer fractions, with potential biological benefits over fractionated regimens.

Aim: To implement an SBRT protocol for managing locoregional recurrence in HNC patients ineligible for surgery.

Methodology: A retrospective analysis was conducted on 10 previously treated HNC patients. The SBRT Planning Target Volume (PTV) was based on the 70Gy PTV, with re-irradiation constraints adapted from RTOG 3507. VMAT 6x FFF beams were used, with full or partial arc arrangements. All treatment plans passed departmental quality assurance standards.

Results: After demonstrating feasibility, the technique was applied to clinical patients. All patients underwent simulation with a Planning CT, MRI and PET. Highly conformal plans were generated, ensuring ≥95% of PTV coverage. Each plan was reviewed by two Radiation Oncologists with imaging thresholds of 1.5mm, 1.5 deg rotation using CBCT and ExacTrac kV Imaging. Ten patients underwent SABR, including one second reirradiation for regional recurrence. Mean treatment duration was 5fx over 14 days. Subsites included oropharynx (n=4), nasopharynx (n=1), oral cavity (n=3), larynx (n=1), and neck/SCF (n=1). Six patients received reirradiation for recurrence 1–4 years post-standard 63–70Gy; two were treated definitively due to inoperability. Toxicities were mild with no grade ≥3 events. Two patients had local recurrence at 2 and 12 months. Of six reirradiation cases, three maintained local control at 12 months, two developed regional recurrence, and one had distant metastasis. In two de novo cases neither recurred locally.

Conclusion: HN SBRT was successfully implemented for ten patients, demonstrating its feasibility as an effective and safe treatment option with minimal toxicity and favourable outcomes.

PP-046

E-Poster Viewing
SBRT – LUNG

DOSIMETRIC CHARACTERISTICS OF LUNG STEREOTACTIC BODY RADIATION THERAPY ON HALCYON

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Purpose: To evaluate the dosimetric characteristics and feasibility of the Halcyon system for lung Stereotactic Body Radiation Therapy (SBRT) by comparing multiple-arc VMAT plans on Halcyon with clinical plans generated on the TrueBeam STx.

Methods: Five lung SBRT patients (48 Gy in 4 fractions; PTV 6–16 cm^3) treated using a Partial Arc technique (no avoidance sector) on TrueBeam STx were replanned on the Halcyon system. Halcyon plans utilized 3 to 5 arcs, employing both Partial Arc (with and without avoidance sectors) and Full Arc(358° rotation) techniques. All plans were calculated using the Acuros XB algorithm (**Eclipse v18**). Plans were normalized such that 95% of the PTV received the prescribed dose, adhering to RTOG 0915 constraints. Analyzed indices included Conformity Index (CI), Homogeneity Index (HI), high-dose spillage ($V_{105\%}$), low-dose spillage (D_{2cm} and $R_{50\%}$) and Lung V_{20Gy}.

Results: The CI for Halcyon plans (range:0.98–1.1) using 3~5 arcs was comparable to that of TrueBeam STx. Depending on arc configuration, HI on Halcyon was similar to TrueBeam STx or showed a trend of being up to 20% higher. High-dose spillage($V_{105\%}$) remained =<2%, and intermediate-dose spillage(D_{2cm} and $R_{50\%}$) met RTOG 0915 criteria (no or minor deviation). Notably, depending on PTV size, the 3-arc Partial technique tended toward higher high-dose spillage compared to other techniques. There was no significant difference in Lung V_{20Gy} between the two systems. Monitor Units (MU) were generally 10~30% higher for Full Arc technique compared to Partial Arc technique.

Conclusions: The Halcyon system is capable of delivering highly conformal lung SBRT that meets RTOG 0915 dosimetric criteria. While C-arm linacs (e.g., TrueBeam STx) may face rotation range limitations depending on PTV location, Halcyon offers fewer constraints on arc rotation. By utilizing adequate multiple arcs and optimized rotation ranges, the Halcyon system is useful for managing dose spillage, dose homogeneity and MUs while maintaining high conformality.

PP-047

E-Poster Viewing
SBRT – OLIGOMETASTASES

PATTERNS OF SBRT UTILIZATION AND CLINICAL OUTCOMES: TEMPORAL TRENDS, SURVIVAL, AND EARLY MORTALITY

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Purpose: To analyze patterns of SBRT utilization and associated clinical outcomes in a single academic institution, with the goal of providing insights into clinical practice and patient selection.
Methods: Patients treated with SBRT were identified from a prospectively maintained institutional registry. SBRT was defined as treatment delivered in ≤5 fractions with ≥6 Gy per fraction and an ablative dose level, meeting site-specific BED_{10} thresholds. We analyzed temporal trends of SBRT utilization, treatment site, and tumor type. Overall survival (OS) was calculated from SBRT to death from any cause, and early mortality (≤3 months) was specifically assessed.
Results: A total of 5,119 SBRT patients with 7,438 treatment sessions between 2008 and 2024 were identified. The number of SBRT treatments increased more than 100-fold from 2008 (n = 1) to 2023 (n = 1,342), with a particularly sharp rise in the metastatic setting after 2019–2020. The most common treatment site was the spine (31%), followed by lung (26%), non-spine bone (23%), liver (11%), and lymph nodes (5%). Less common indications included prostate (82), kidney (17), and breast (10), and benign lesions (6). Dose-fraction patterns shifted over time, and since 2020, the 5-fraction regimen has become predominant (40% in 2020 and 69% in 2024). 5-year OS differed by primary tumor histology, treatment site, and metastatic class. According to metastatic class, OS was 75% for local recurrence, 69% for oligometastases, and 50% for polymetastases. Early mortality occurred in 5.4% of patients, predominantly cancer-related (4.5%), while SBRT-related causes were rare (0.1%). Patients treated for bone metastases in the polymetastatic setting had a higher risk of early mortality on multivariate analysis.
Conclusion: In our institutional experience, SBRT utilization has expanded substantially, while the pace of adoption has varied across disease sites. Continued efforts are warranted to standardize practice patterns, refine prognostication, and optimize patient selection.

PP-048

E-Poster Viewing
SBRT – OLIGOMETASTASES

MR-GUIDED SBRT FOR ADRENAL METASTASES – A SINGLE-INSTITUTION EXPERIENCE OF GTV CHANGES, TOLERABILITY AND EFFICACY

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Purpose This study evaluated gross tumour volume (GTV) changes in patients receiving MR-guided radiotherapy (MRgRT) to adrenal metastases, and its tolerability and efficacy.

Methods and Materials This analysis of a single institution registry assessed 15 patients treated with SBRT (receiving 35-50Gy in 5-6 fractions) to adrenal metastases on the Unity MR-Linac. The endpoints were GTV changes between simulation and first fraction and all fractions, acute and late toxicities (CTCAE v5.0), local and distant control and overall survival.

Results The cohort had a median age of 71 years (63-81 years). The most common primaries were non-small cell lung cancers (33.3%, n=5) followed by renal cell carcinomas (20%, n=3) and melanomas (13.3%, n=2). All but 1 participant (93.3%) previously received systemic therapy. The median baseline GTV at simulation was 8.82cm3 (range 3.63 to 34.897cm3). The median GTV for first and final fractions was 9.05cm3 and 8.8cm3 respectively. The mean percentage change in GTV volume from simulation to final fraction was 11.03% (range -12.06 to 38.08%). 33.3% (n=5) of cases had decreasing GTVs from simulation to final fraction. Turning to tolerability, no > grade 3 toxicities were observed during the first 12 months post radiotherapy. The most common acute toxicity was fatigue (80%, n=12), followed by nausea (20% n=3) while fatigue (13.3%, n=2) was the most common late toxicity. As to efficacy, at the 12-month interval, 33.3% (n=5) patients had local recurrence and 60% (n=9) had distant progression, and overall survival was 93.3% (n=14).

Conclusion While data analysis continues, the variations in GTV and local control rates in our preliminary results emphasise the importance of adaptive replanning for enhancing dosimetry and efficacy. The low rates of severe toxicities support the role of adaptive replanning in treating adrenal metastases. The correlation between GTV variation and outcome data will be evaluated in future studies.

PP-049

E-Poster Viewing
SBRT – OLIGOMETASTASES

FRACTIONATED STEREOTACTIC RADIOTHERAPY (FSRT) FOR OLIGOMETASTATIC DISEASE: A SINGLE-CENTER EXPERIENCE FROM BANGLADESH

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Overall Survival (OS)

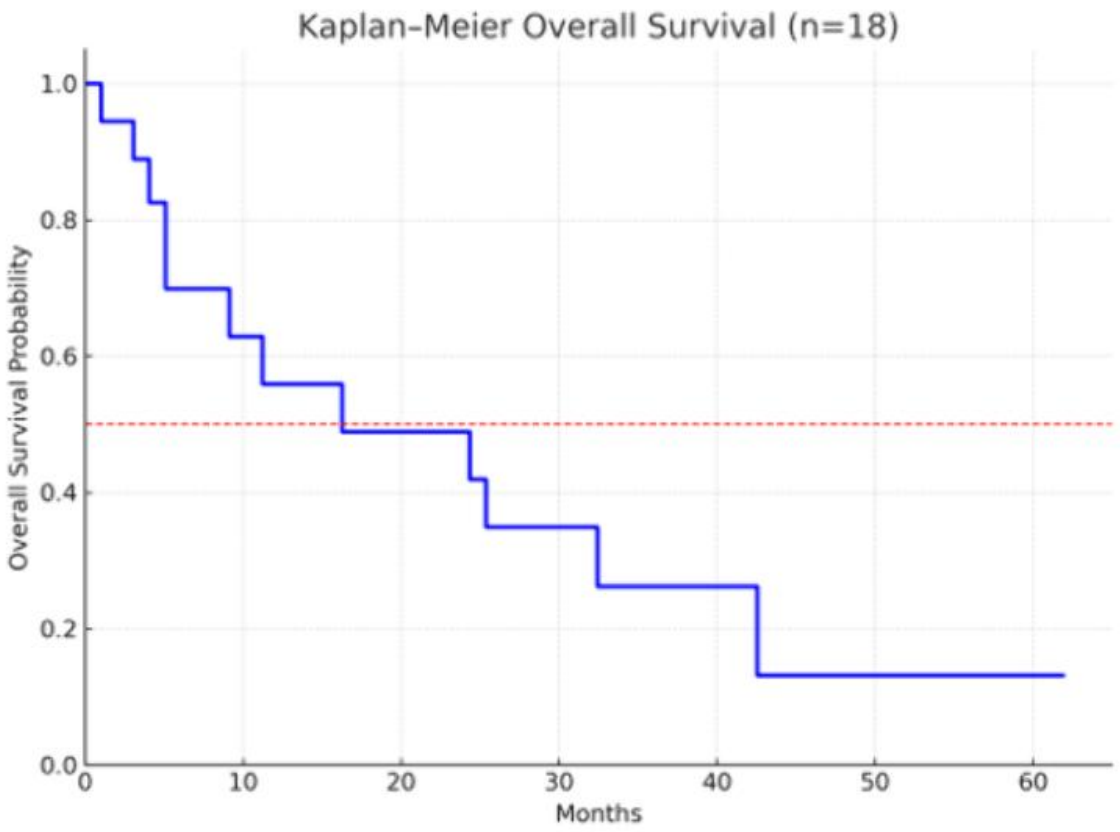

Figure 1. Kaplan–Meier curve for **Overall Survival** in 18 patients treated with FSRT between 2020–2025. Time zero is the completion of FSRT. Patients alive at last follow-up (December 2025) are censored (tick marks on curve). The red dashed line indicates 50% survival probability. **Median OS was approximately 16 months** for this cohort. By the end of follow-up, the 5-year OS rate was ~13%, as only 6 patients remained alive (censored)

Progression-Free Survival (PFS)/ Local Control

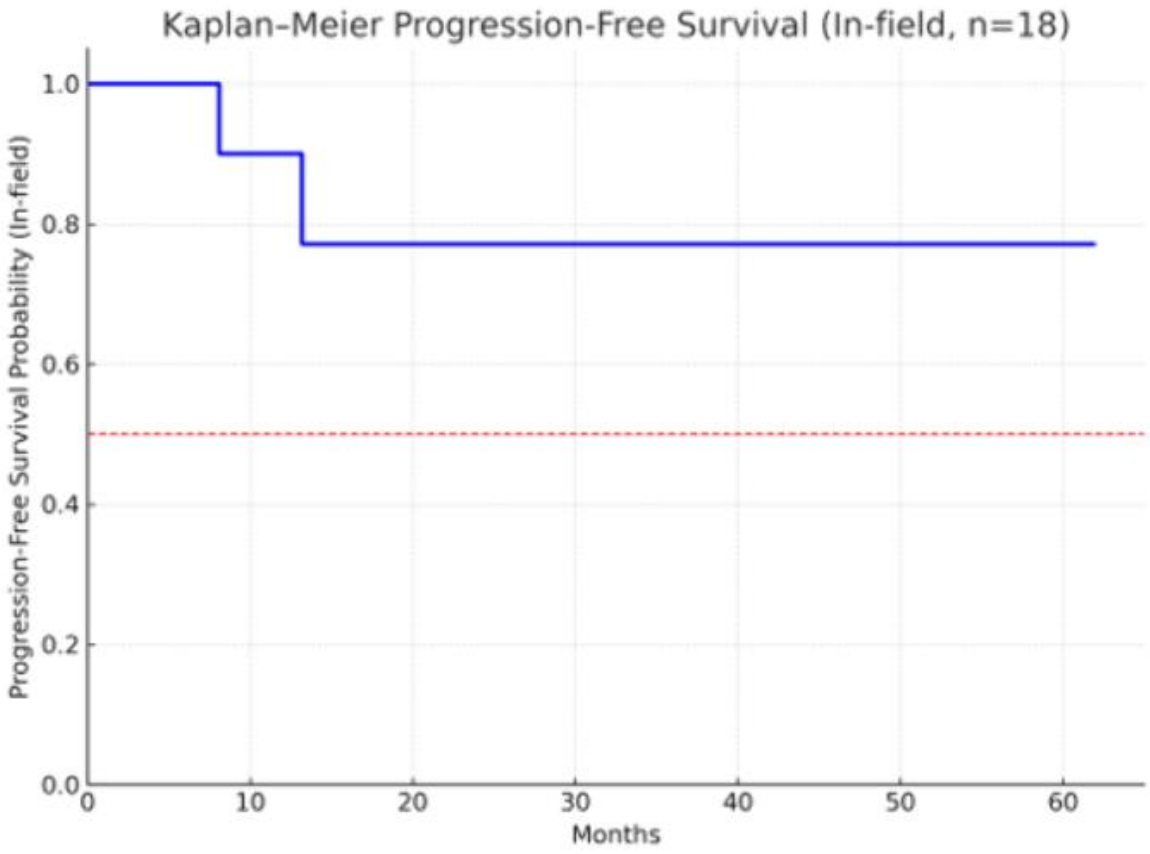

Figure 2. Kaplan–Meier curve for **Progression-Free Survival (In-field)**. Only **in-field progression** events are counted as failures; distant metastases and deaths without local progression are censored【10†】. Tick marks indicate patients with no in-field failure by December 2025 (censored at last follow-up). The PFS curve starts high – only **2 out of 18 patients (11%)** experienced in-field recurrence during the study period. The red line (50% level) is never crossed, indicating **median in-field PFS was not reached**【10†】. In fact, the **local control rate** remained ~77% at 3–5 years post-FSRT (i.e. ~77% of patients had no in-field tumor progression by last follow-up).

The details information about the selected cases and the outcome are presented in Table 1.

Sl No	Age	Sex	Primary Site Diagnosis	Metastatic Site	Metastatic Lesion No	Prescription dose In Gy	Fraction No	PF during RT 0/5	Month Of Survival without CNS progression during RT	OS in months
1	36	F	Breast	Brain	1	25	5	0	6.03	42.57
2	60	F	Thymus	Brain	1	25	5	0	61.90	61.90
3	61	F	Breast	Brain	1	25	5	2	8.10	32.43
4	82	F	Colon	Brain	1	27	3	0	4.07	4.07
5	67	M	Lung	Brain	2	27	3	0	16.27	16.27
6	56	M	Lung	Brain	1	27	3	2	1.00	1.00
7	47	M	Lung	Brain	1	27	3	0	24.33	24.33
8	67	M	Lung	Brain	2	27	3	0	11.23	11.23
9	54	F	Breast	Brain	1	27	3	0	4.07	5.10
10	53	M	Esophagus	Brain	1	27	3	0	37.57	37.57
11	64	M	Lung	Brain	1	27	3	0	29.47	29.47
12	55	F	RCC	Brain	1	27	3	0	9.13	9.13
13	48	M	Lung	Liver	1	50	5	0	3.07	3.07
14	52	M	Lung	Brain	2	24	3	2	5.10	5.10
15	53	F	Colon	Liver	2	50	5	0	6.13	6.13
16	69	M	Lung	Brain	2	27	3	0	4.03	4.03
17	72	M	Colon	Bone	2	30	5	1	4.03	4.03
18	65	M	Colon	Lung	1	55Gy	5	1	13.17	25.37

Background:

Oligometastatic disease represents a biologically intermediate state where aggressive metastasis-directed therapy may improve durable disease control. Fractionated stereotactic radiotherapy (FSRT) enables safe delivery of ablative doses to intracranial and extracranial lesions. We report updated outcomes of linac-based FSRT with the inclusion of an additional patient.

Materials and Methods:

This retrospective single-center analysis included 18 patients treated with FSRT between 2020 and 2025. All patients had 1–3 metastatic lesions involving the brain (n = 15), liver (n = 2), or bone (n = 1) and an ECOG performance status of 0–2. Target delineation was performed using CT–MRI fusion in Eclipse TPS with a 2-mm GTV-to-PTV margin. FSRT was delivered using a linear accelerator, most commonly 25–55 Gy in 3–5 fractions, individualized based on lesion size, location, and prior therapies. Outcomes assessed included local control (LC), progression-free survival (PFS), overall survival (OS), and toxicity.

Results:

Median age was 56 years (range 36–82), with 61% male patients. Primary tumor sites included lung (~45%), breast (~22%), colorectal (~17%), and others. At a median follow-up of approximately 11 months, 17 of 18 treated lesions (94%) achieved durable local control. One in-field recurrence occurred in a breast cancer patient treated with a comparatively lower biologically effective dose (BED). Distant progression outside the treated field was observed in five patients. Median OS was 9.3 months, and median PFS was 6.2 months, with several long-term survivors exceeding 60 months. FSRT was well tolerated, with no grade ≥3 acute or late toxicities.

Conclusion:

Linac-based FSRT provides excellent local control with minimal toxicity in carefully selected

oligometastatic patients involving brain, liver, and bone. Higher BED regimens were associated with superior in-field control. FSRT is an effective metastasis-directed strategy that may delay systemic progression and prolong survival with efficient utilization of high-volume radiotherapy resources.

PP-050

E-Poster Viewing
SBRT – PANCREAS AND LIVER

STEREOTACTIC BODY RADIOTHERAPY IN PATIENTS WITH HEPATOCELLULAR CARCINOMA NOT CANDIDATES FOR SURGERY: ONCOLOGICAL RESULTS AT THE NATIONAL INSTITUTE OF MEDICAL SCIENCES AND NUTRITION SALVADOR ZUBIRÁN IN MEXICO

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Introduction: Hepatocellular carcinoma (HCC) is a neoplasm with high mortality rates. Eighty percent of patients are not surgical candidates. SBRT has shown promising results.

Objective: To evaluate the oncological outcomes of patients with hepatocellular carcinoma treated with SBRT.

Materials and Methods: Retrospective review of patients treated with SBRT. Inclusion criteria: Unresectable HCC, Karnofsky score >60, any clinical stage, Child-Pugh score ≤8, and an unaffected liver volume >700 cm^3. Primary Endpoint: Local control. Secondary Endpoints: Overall survival and progression-free survival. Acute adverse events such as gastrointestinal or hepatic disturbances, biochemical abnormalities in liver function tests, and tumor markers.

Results: From January 2019 to June 2025, 29 patients with hepatocellular carcinoma treated with SBRT were recruited at the INCMNSZ. Twenty-seven patients had been previously treated with surgery, TACE, TARE, alcohol, ARF, or TAE, or a combination of techniques, in cases of recurrence or new liver tumors. All patients underwent SBRT on the Varian Truebeam V2.5 linear accelerator (Varian Medical Systems/Siemens Healthcare) and were positioned using the Qfix Stradivarius fixation system with abdominal compression to reduce respiratory motion, or with free breathing and fiducial marker tracking in those patients for whom this was possible. The dose delivered to healthy organs is available in Table 3. One patient received a single dose of 26 Gy**.** Local Control. The median follow-up for radiological response was 11 months (IQR 2-14). Only one local recurrence event in the radiotherapy field was reported during follow-up. The probability of local control at 1, 2, and 3 years was 95% at each time point. Progression-Free Survival. A total of 11 patients experienced disease progression during follow-up; only 1 had local progression, while the others had intrahepatic and systemic progression.

Conclusion: The results of this study demonstrated that SBRT achieved excellent local control of HCC in a selected population,

PP-051

E-Poster Viewing
SBRT – PANCREAS AND LIVER

STEREOTACTIC BODY RADIATION THERAPY (SBRT) FOR PRIMARY LIVER AND PANCREATIC TUMORS UNDER TOTAL INTRAVENOUS ANESTHESIA

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Background Less than 30% of patients with primary liver or pancreatic tumours are eligible for surgical resection. SBRT has emerged as an effective ablative alternative; however, respiratory-induced motion in upper abdominal targets introduces geometric uncertainty and limits the safe reduction of CTV–PTV margins. Total intravenous anesthesia (TIVA) with endotracheal intubation allows for controlled mechanical ventilation, providing reproducible respiratory patterns and reducing intrafraction motion to levels unachievable with voluntary breath-hold or abdominal compression.

Methods Between October 2022 and November 2025, 383 consecutive patients with primary or metastatic liver and pancreatic tumours were treated with single-fraction SBRT under TIVA. Patients were intubated and mechanically ventilated to achieve full immobilisation and stable tidal volumes. PTV margins were reduced, enabling highly conformal dose delivery. All patients received a single ablative fraction corresponding to BED 10 = 129 Gy. CBCT was performed pre-treatment for target verification and residual motion assessment.

Results No acute toxicities of grade ≥ 3 were observed. Mechanical ventilation markedly improved motion stability in both hepatic and pancreatic targets, allowing high-dose conformal delivery while respecting organ-at-risk constraints. When compared with patients treated in Deep Inspiration Breathold (DIBH), Liver treatment under TIVA showed significantly smaller intrafractional displacements in three main translational directions. Preliminary dosimetric and clinical data demonstrate excellent reproducibility, minimal motion-induced geometric error, and promising early local tumour control.

Conclusions SBRT under TIVA is a safe, feasible, and highly precise approach for selected liver and pancreatic tumour patients requiring strict motion control. Stabilising respiratory motion and reducing geometric uncertainty allows reliable ablative dose escalation with optimal organ-at-risk sparing. Successful implementation relies on multidisciplinary collaboration among radiation oncologists, medical physicists, anesthesiologists, and radiation therapists.

PP-052

E-Poster Viewing
SBRT – PANCREAS AND LIVER

NOVEL APPROACH OF USING LIVER DOME AS SURROGATE FOR REAL TIME MOTION TRACKING OF TUMORS IN LIVER STEREOTACTIC BODY RADIOTHERAPY WITHOUT FIDUCIALS.

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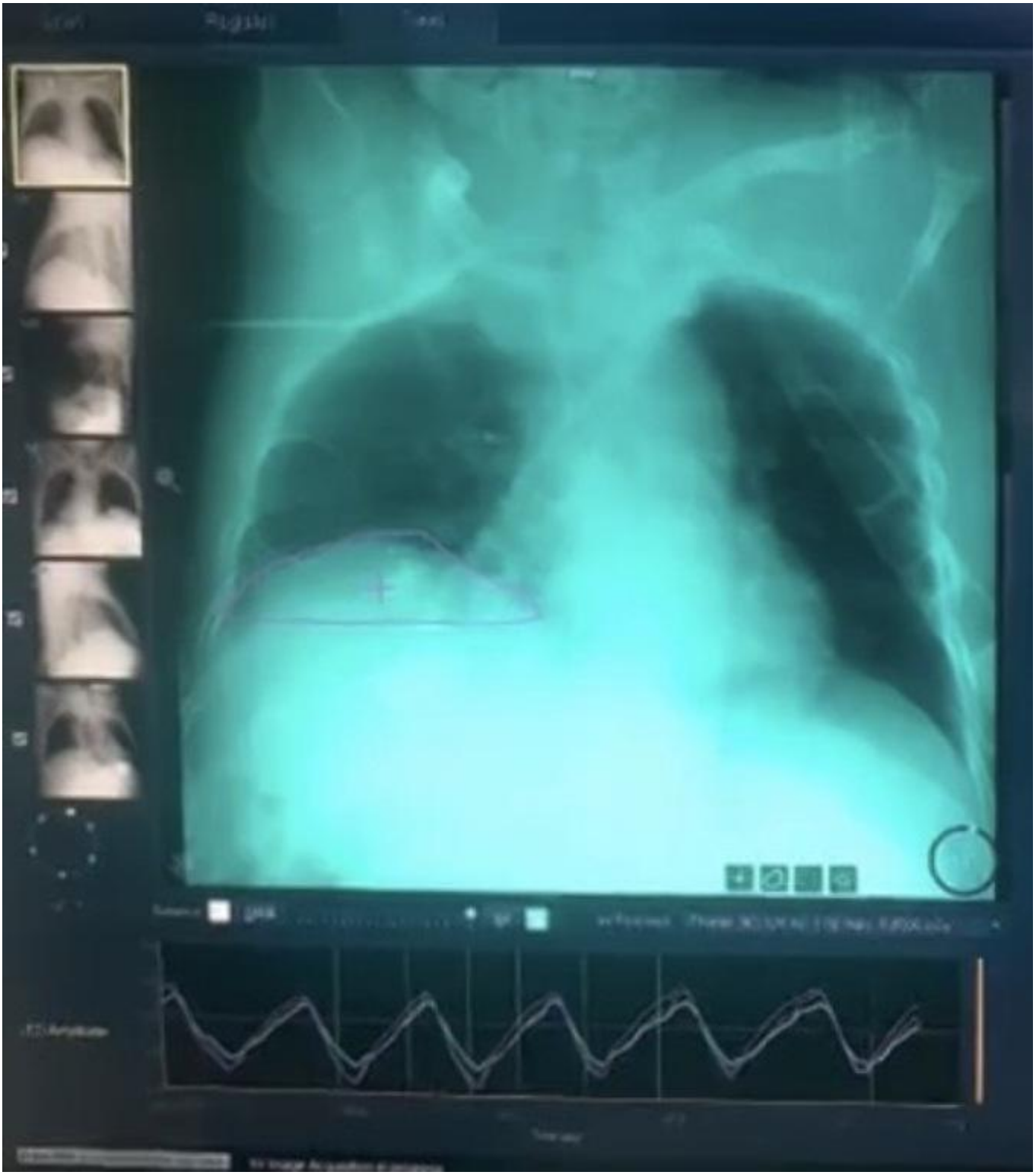
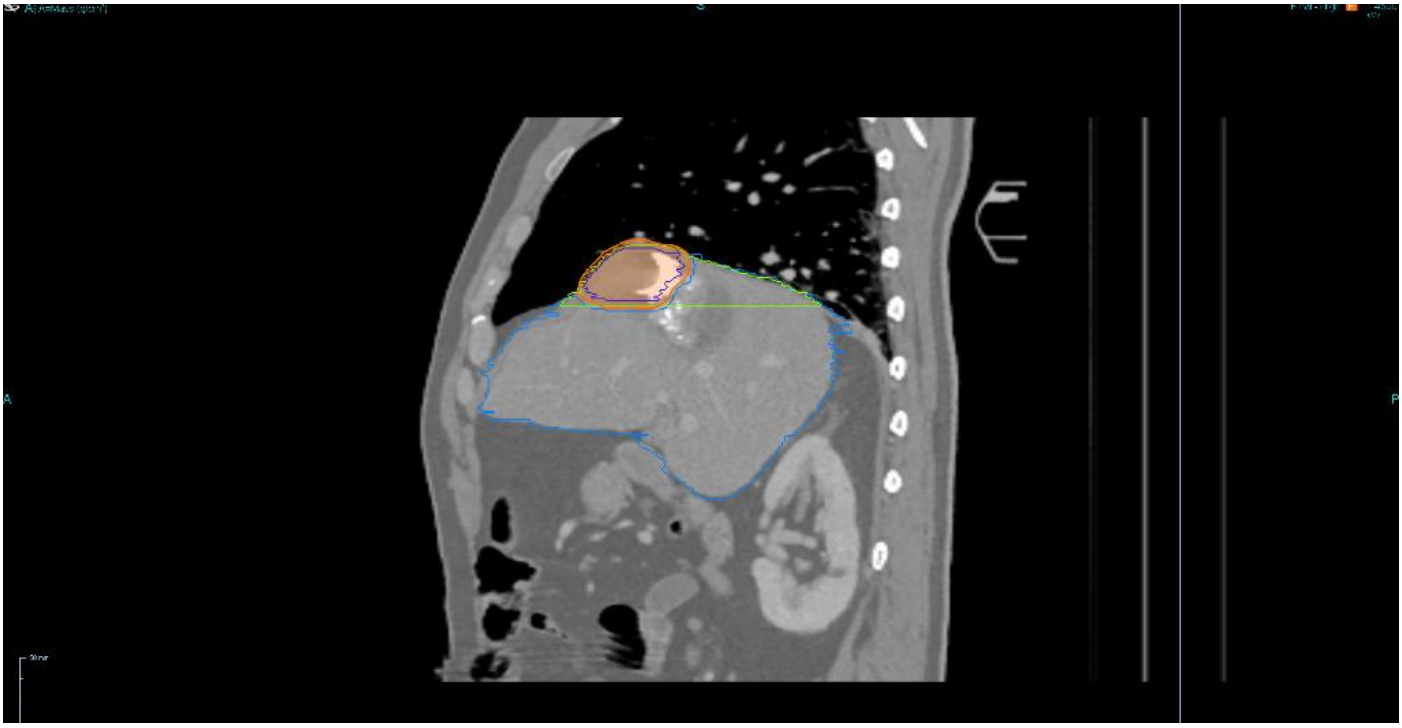
Background Stereotactic body radiotherapy (SBRT) is one of the treatment modality for treating liver metastasis as well as in Hepatocellular carcinoma. Using effective motion management techniques is important in delivering high dose to liver tumor with precision. We studied the feasibility and outcome of patients treated using Liver Dome for real time motion tracking in Liver SBRT on helical delivery platform.

Materials and Methods: We studied 9 patients with liver metastasis or Hepatocellular carcinoma whose tumor was located near Liver dome treated at our institute from July 2024 to October 2025. Median age of presentation was 55 years (45-70 years). Mean tumor size was 3.5 cm. All patients received dose of 50 Gy in 5 fractions at 10 Gy per fraction for 5 consecutive days. Gross tumor with margins and Liver dome was contoured on simulation CT scan. Patients underwent SBRT using Liver dome as a surrogate for synchrony based real time motion tracking on a helical delivery platform without fiducial
implants.





Results: Median follow up was 6 months (3 – 12 months). Patients were evaluated with MRI Liver (Plain + contrast) for response assessment. 8 patients had complete response on post treatment MRI Liver at 3 months. 1 patient had partial response. No grade 3 toxicities were observed in these patients.

Conclusion: We conclude that this novel technique of using Liver dome for synchrony based real time motion tracking in liver SBRT is feasible and can be used as a safe alternative to fiducial implants.

PP-053

E-Poster Viewing
SBRT – PANCREAS AND LIVER

SBRT AFTER NEOADJUVANT CHEMOTHERAPY (NAC) FOR LOCALLY ADVANCED PANCREATIC CANCER (LAPC): FIVE YEARS INSTITUTIONAL RESULTS.

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Background
NAC for tumor downstaging, better local/distal disease control, and higher R0 resection rate, followed by pancreatectomy are the two pillars of the management of LAPC. The potential additional role of SBRT remains controversial.
Materials and Methods
In our tertiary referral center, patients with LAPC undergo a complete course of NAC (mostly FOLFIRINOX), cross-sectional imaging reevaluation in 2 weeks and exploration for possible resection when the tumor looks resectable, en-block with the involved major vascular structure(s). Recently, when such a resection did not look feasible and there was no disease progression, we initiated a program of SBRT (5fr/8Gy per fraction/40Gy total dose), with no concurrent chemotherapy. A month after SBRT, patients were restaged (CT with pancreatic protocol) for possible resection.
Results
Thirty-six patients (20 males/16 females, median age: 59, ECOG-PS score: 0-1) with LAPC underwent SBRT a median of 27 days following NAC (Aug. 2019 – Aug 2025). No SBRT-related side effects occurred. Follow-up was complete (Dec. 2025) with a median of 22 months. Seventeen patients
(47%) were subsequently explored for possible resection, a median of 2 months after SBRT, and in 13 of them (76%, or 36% of the total) a pancreatectomy was performed. R0 resection was achieved in 11 (88%). Eight patients are alive and well at 11, 14, 19, 21, and 31 months since diagnosis and three patients died at 13, 22, and 27 months. The 4 patients explored, but not resected, had complete encasement of the common and proper hepatic artery from its origin to its bifurcation (2 patients), or micrometastatic liver, or peritoneal disease (1 patient each).
Conclusions
Our initial experience shows that SBRT following NAC for LAPC is safe, is associated with a high rate of local control and may render resectable about one third of patients considered unresectable after NAC alone.

PP-054

E-Poster Viewing
SBRT – PANCREAS AND LIVER

APPLICABILITY OF DEEP LEARNING ASSISTED INTERNAL MARGIN GENERATION IN SBRT FOR HEPATOCELLULAR CARCINOMA USING 4D CT WITH FREE BREATHING

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Objectives: Stereotactic body radiotherapy (SBRT) is a standard treatment for Hepatocellular carcinoma (HCC). 4DCT with free breathing is commonly used as a motion management strategy. However, internal margin (IM) generation is operator-dependent as tumour is often not visualised on 4DCT. This study aims to evaluate the feasibility of deriving IM using a deep learning (DL) assisted workflow in patients with HCC treated with SBRT.

Methods: We retrospectively analysed 8 consecutive patients with 10 HCC lesions treated with SBRT under free breathing between January and April 2025. The 4DCTs were reviewed to ensure the tumours can be clearly visualised across all phases. The oncologist-derived IM were verified by an expert oncologist specialising in liver SBRT. As the tumours can be visualised across respiratory phases, the IM is representative of true tumour motion. A DL based auto-contouring model was used to contour all liver segments. The tumour-harbouring liver segment was used as a surrogate for tumour motion. Affine transformation matrix was derived to track liver segment movement across respiratory phases. The resultant IM was then computed and compared against oncologists-derived IM.

Results: Among the lesions, 6 were located in the left lobe and 4 in the right lobe. The mean oncologist-derived IM was 14.5 mm, while the mean DL-derived IM for the tumour-containing segment was 15.2 mm. Paired t-test analysis showed a t-value of -0.9 and a p-value of 0.39, indicating no statistically significant difference between oncologist- and DL-derived IM. Average runtime for the workflow was 8 minutes.

Conclusion: The DL-assisted workflow demonstrated the capability to derive IM comparable to that of experienced oncologists with significant time savings, supporting its potential integration into liver SBRT planning workflows.

PP-055

E-Poster Viewing
SBRT – PANCREAS AND LIVER

A PROSPECTIVE PILOT STUDY ON EFFICACY AND SAFETY OF PALLIATIVE SPATIAL FRACTIONATED RADIATION THERAPY FOR LIVER TUMOURS

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Objectives Spatial fractionated radiation therapy (SFRT) has been gaining acceptance as palliative radiotherapy (RT) for liver tumours and may offer dosimetric and therapeutic advantage of tumour control and symptom relief, compared to traditional 2-dimensional or 3-dimensional RT. We have conducted a prospective pilot study on SFRT in patients with metastatic liver tumours, and evaluated the magnitude of symptom relief and toxicity after SFRT.

Methods Patients with inoperable advanced or metastatic primary or secondary liver malignancies presented with abdominal pain or distension or other associated symptoms and have previously failed at least 1 line of systemic anticancer treatment were invited. After baseline investigations with computed tomography with or without magnetic resonance imaging for target volume delineation, they underwent either stereotactic centralized ablative radiation therapy (SCART) or lattice SFRT with either 15Gy/8Gy/1 fraction or 60Gy/30Gy/5 fractions encompassing the central portion of the gross target volume (GTV) within a 1.5cm inner margin of GTV for SCART or the lattices.

Results Eight patients were recruited including 4 males and 4 females. Four had hepatocellular carcinoma, 2 had uveal and nasal melanoma with liver metastases, 1 had sarcoma of the liver and 1 had ileal adenocarcinoma with liver metastases. The median pretreatment Brief Pain Inventory score (BPI) was 6 (ranging from 4-10). Six and two patients received lattice SFRT and SCART, respectively. After a median follow-up of 3.2 months (range 2.0-6.5), the median BPI score improved to 3 (range 0-4) and 2 (range 0-2) at 1 month and 3 months after SFRT (both p=0.03). One had partial response, 6 had stable disease, and the remaining 1 had progressive disease. No acute liver impairment or other treatment-related adverse events were observed, up to 6 months after SFRT.

Conclusion SFRT may offer better symptom relief with minimal toxicities compared to traditional technique for inoperable advanced liver malignancies.

PP-056

E-Poster Viewing
SBRT – PANCREAS AND LIVER

ASSESSING POSITIONAL ACCURACY AND BODY-SHAPE REPRODUCIBILITY OF BELT INTEGRATED WITH AIRBAG VERSUS THERMOPLASTIC MASK WITH AIRBAG COMPRESSION SYSTEMS FOR ABDOMINAL RADIOTHERAPY MOTION MANAGEMENT IN STEREOTACTIC BODY RADIOTHERAPY.

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Purpose:
Abdominal compression used in radiotherapy to reduce respiratory motion and improve target localization. This study compares two compression systems: (1) a compression belt with an integrated inflatable air bag and (2) an abdominal thermoplastic mask with an inflatable air bag but without a belt. The objective was to evaluate the accuracy of inflatable air-bag positioning, the reproducibility of applied compression, and the consistency of patient body shape across treatment sessions.

Methods:
Twenty patients who underwent treatment for abdominal or thoracic stereotactic body radiotherapy using abdominal compression were retrospectively analyzed. The accuracy and reproducibility of the compression system were evaluated by measuring the displacement of the airbag and the abdominal surface with Body shape variation. This was quantified using ClearRT based kVCT imaging during treatment on tomotherpy. Variations in the delivered dose due to abdominal shape deformation were assessed by replanning on kVCT images. Statistical analyses were performed to compare the performance of the two systems.

Results:
Both systems effectively facilitated abdominal compression. However, the compression belt with an inflatable air bag showed greater variation in airbag positioning and abdominal body shape. On the other hand, the thermoplastic system with inflatable airbag demonstrated superior reproducibility of abdominal body shape and more stable airbag placement, due to its rigid structure and the embossed housing of the airbag within the thermoplastic material.

Conclusion:
The compression belt with inflatable air bag and the thermoplastic system with inflatable air bag each offer distinct advantages in abdominal compression for radiotherapy. Understanding these differences can support selection of optimal compression techniques to improve respiratory motion management and treatment precision in stereotactic body radiotherapy.

PP-057

E-Poster Viewing
SRS – BRAIN METASTASES

NABAA EFFICIENCY INDEX (NEI) FOR IMPROVED CROSS-MODALITY PLAN QUALITY ASSESSMENT IN GAMMA KNIFE AND LINAC-BASED SRS

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Purpose: To evaluate a new dimensionless plan quality metric—the Nabaa Efficiency Index (NEI)—that integrates geometric conformity and dose-energy efficiency for stereotactic radiosurgery (SRS) and fractionated radiotherapy. NEI provides a unified mathematical framework to compare Gamma Knife radiosurgery and linac-based SRS, addressing limitations of existing indices that quantify only geometry or dose gradient independently.

Methods: NEI is formulated as the product of a conformity term and the Dose Efficiency Ratio, defined using mean dose to the target and mean dose within a prescribed isodose envelope. Two variants were evaluated: NEI_{50} (gradient-sensitive, assessing 50% isodose behavior) and NEI_{90} (high-dose conformity efficiency). Clinical validation was performed using 100 stereotactic plans (50 Gamma Knife, 50 VMAT-SRS), all prescribed 30 Gy in 3 fractions. Statistical analysis included ANOVA, ROC/AUC, correlation, and Decision Curve Analysis to compare NEI with the Paddick Efficiency Index and established conformity metrics.

Results: Gamma Knife plans showed significantly higher NEI_{50} (0.94 ± 0.06) than VMAT-SRS (0.86 ± 0.12, $p < 0.001$), indicating superior intermediate-dose control. High-dose conformity did not differ significantly between modalities. NEI_{90} demonstrated the strongest discrimination of clinically optimal plans (AUC 0.902 for Gamma Knife; AUC 0.977 for VMAT-SRS). Pooled analysis (n=100) yielded AUC 0.941 (sensitivity 0.863, specificity 0.931). Decision Curve Analysis showed greater clinical benefit for NEI_{90}, particularly for linac-based SRS across threshold probabilities 0.40–0.60.

Conclusion: NEI provides a unified, modality-agnostic measure of plan quality capturing both geometric and energetic efficiency. NEI_{90} is a powerful discriminator for prescription-dose quality, while NEI_{50} complements it by sensitively reflecting dose-gradient and spill control. The index is suitable for integration into automated plan ranking, QA workflows, and cross-institutional standardization in SRS.

PP-058

E-Poster Viewing
SRS – BRAIN METASTASES

COGNITIVE AND QUALITY OF LIFE (QOL) DATA AT 6 MONTHS POST STEREOTACTIC RADIOSURGERY (SRS).

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Aim To assess cognitive and QoL changes in participants that have undergone Stereotactic Radiosurgery (SRS) treatment. We present the 6-month results from the prospective cohort of the CoDe-B-Rad Study (NCT06466720).

Methods Sixty-one participants with brain metastases (n=51) and meningiomas (n=10) were recruited prospectively in the CoDe-B-Rad study. All participants were treated at Nottingham University Hospitals NHS Trust, UK. The Montreal cognitive assessment (MoCA) was used along with QoL questionnaires QLQ-C30 and BN20 to assess cognition and QoL at baseline and at 6 months post treatment. The minimal clinically important difference for the MoCA was 3 points, and 10 points in the pre- and post-treatment QLQ scores was considered clinically significant (Maringgwa (2011), Dirven (2021)).

Results Participants' mean age at consent was 65.7 yrs (range: 30-85). At baseline a total of 32 (52%) of participants presented with mild cognitive impairment (MCI) on MoCA, while 29 (48%) scored within the normal range. At 6 months a total of 36 (59%) participants were tested. Seven participants (12%) showed a decline on MoCA, for one (2%) being significant. For 29 (48%) participants there was an improvement on MoCA with eight (13%) being clinically significant. The mean GlobalHealthStatus (GSH)/QoL±SD was 56.13±28.46 and 62.31±22.68 at 6 months and baseline respectively. The mean change in GHS/QoL between pre- and post-treatment was -5.88. Twelve (20%) and ten (16%) participants saw a significant deterioration and improvement respectively in their GSH/QoL post-treatment. Mean insomnia, future uncertainty, and median social functioning showed a clinically significant deterioration for the cohort.

Conclusion Results from the prospective cohort of the CoDe-B-Rad study at 6 months suggest that nearly 50% of patients that receive SRS their cognition improves at 6 months post SRS. GHS/QoL remains unchanged with insomnia, future uncertainty and social functioning showing a clinically significant deterioration post-treatment.

PP-059

E-Poster Viewing
SRS – BRAIN METASTASES

VIABLE TUMOR RECURRENCE IS A MAJOR CAUSE OF LOCAL FAILURE AFTER BEVACIZUMAB THERAPY FOR RADIATION NECROSIS IN BRAIN METASTASES TREATED WITH STEREOTACTIC RADIOSURGERY

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Background Bevacizumab (BVZ) is known to be effective to control radiation necrosis (RN) following stereotactic radiosurgery (SRS) for brain metastases (BMs), although treatment failure may occur. Here, we investigated the incidence and pattern of local failure after BVZ therapy for RN and its underlying biological mechanism.

Methods We conducted a retrospective analysis on 17 patients who had been treated with BVZ for RN following SRS for BMs between 2016 and 2021. In each patient, the diagnosis of RN was made based on the conventional and advanced MR with or without positron emission tomography. Median 5 cycles (range, 2-10 cycles) of BVZ (5 mg/kg) were administered at 2-week intervals. Treatment response was assessed by volumetric changes of the lesions on MR and patients' neurological status.

Results Treatment response was typically brisk and substantial. Best MR response was seen at median 13 weeks (range, 3-56 weeks) after the start of BVZ with a median volume decrease of 84.5% (range, 38.7-100%) of perilesional brain edema on T2WI and of 54% (range, 2.9-100%) of contrast enhancing lesions on T1WI. Patients' neurological status improved in 16 patients (94.1%) and was stationary in 1 (5.9%). During the median follow-up of 12 months (range, 2-60 months), delayed local failure was observed in 6 patients (35.3%) at median 10 months (range, 6-14 months) after starting BVZ treatment, where viable tumor recurrence was demonstrated in all of them. No reconstitution of RN without viable tumor was observed during the follow-up.

Conclusions Although BVZ was highly effective to control RN following SRS for BMs, delayed local failure frequently occurs owing to viable tumor recurrence. This may imply that much predominant vascular stabilizing effect of BVZ over anti-tumor effect transiently obscures the presence of potential viable tumor cells but does not prevent them from eventual recurrence.

PP-060

E-Poster Viewing
SRS – BRAIN METASTASES

A RETROSPECTIVE SINGLE-INSTITUTION ANALYSIS OF STEREOTACTIC RADIOSURGERY FOR PATIENTS WITH 10 OR MORE BRAIN METASTASES

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Stereotactic radiosurgery (SRS) for patients with >10 metastases is currently evolving with emerging evidence that SRS is well tolerated and associated with a reduced risk of neurocognitive deterioration. We conducted a retrospective data analysis of patients treated at our institution between October 2020 and November 2025. We identified 47 patients that had received one course of linac-based SRS to 10 or more metastases. Treatment was delivered over 5 fractions (5–6 Gy per fraction) for 25 patients, 3 fractions (9 Gy per fraction) for 16 patients, and 1 fraction (18–21 Gy per fraction) for 6 patients. The median number of metastases treated was 13 (10–46) with a median cumulative planning treatment volume of 12.9 cc (2.57–91.53 cc). Primary cancers included Lung or Bronchus (*n* = 18), Breast (*n* = 12), Melanoma (*n* = 9), Kidney (*n* = 4), Head and Neck (*n* = 2), Thyroid (*n* = 1), and Bile duct (*n* = 1). Of the 47 patients, 10 had received at least one prior course of SRS, 4 had received one prior course of whole brain radiotherapy, 6 received a subsequent course of SRS, and 4 received subsequent whole brain radiotherapy. Three patients were identified as having received both prior and subsequent SRS. Whole Brain V24 Gy volumes ranged from 8.52 cc to 223 cc (median = 43.7 cc), V20 Gy volumes ranged from 6.8 cc to 70.4 cc (median = 29.8 cc), and V12 Gy volumes ranged from 14.8 cc to 24 cc (median = 19.2 cc). Interim median overall survival was approximately 7.0 months from date of treatment with a median follow-up time of 5.5 months.

PP-061

E-Poster Viewing
SRS – BRAIN METASTASES

MACHINE LEARNING FOR PREDICTING RADIATION NECROSIS AFTER SRS OF BRAIN METASTASES: A COMPREHENSIVE DOSIMETRIC AND CLINICAL ANALYSIS

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Purpose:
To develop a predictive model for radiation necrosis (RN) risk after SRS for brain metastases by analyzing dosimetric and clinical parameters using statistical and machine learning methods.

Materials and Methods:
A retrospective study included 96 patients with 107 metastatic lesions. SRS was delivered on CyberKnife and Novalis systems with fractionation schemes of 3×8 Gy, 5×6 Gy, and 7×5 Gy. RN incidence was 33.5%. Analyzed parameters included clinical factors and dosimetric parameters: equivalent-to-1-fraction ($\alpha/\beta = 3$) minimum, maximum and mean doses; target volume; V14, V12, V10 including and excluding the target volume; and conformity, homogeneity and coverage indices. Predictor selection used Kolmogorov-Smirnov, Mann-Whitney, and Brunner-Munzel tests for continuous variables, and Fisher's exact test for categorical predictors. Kendall’s correlation matrix was used to reduce multicollinearity. Logistic regression and random forest models were built and evaluated using cross-validation and an independent test set.

Results:
Statistical analysis identified four key predictors of RN risk: V14 excluding the target volume, target coverage index, homogeneity index, and presence of primary peritumoral edema. The logistic regression model demonstrated higher sensitivity (88% vs 75%) and more stable cross-validation performance (F1: 0.569±0.083; AUC: 0.715±0.096) compared to the random forest (F1: 0.632±0.187; AUC: 0.742±0.166). On the independent test set, logistic regression achieved an F1-score of 0.609 and AUC of 0.688, outperforming the random forest (F1: 0.556, AUC: 0.665).

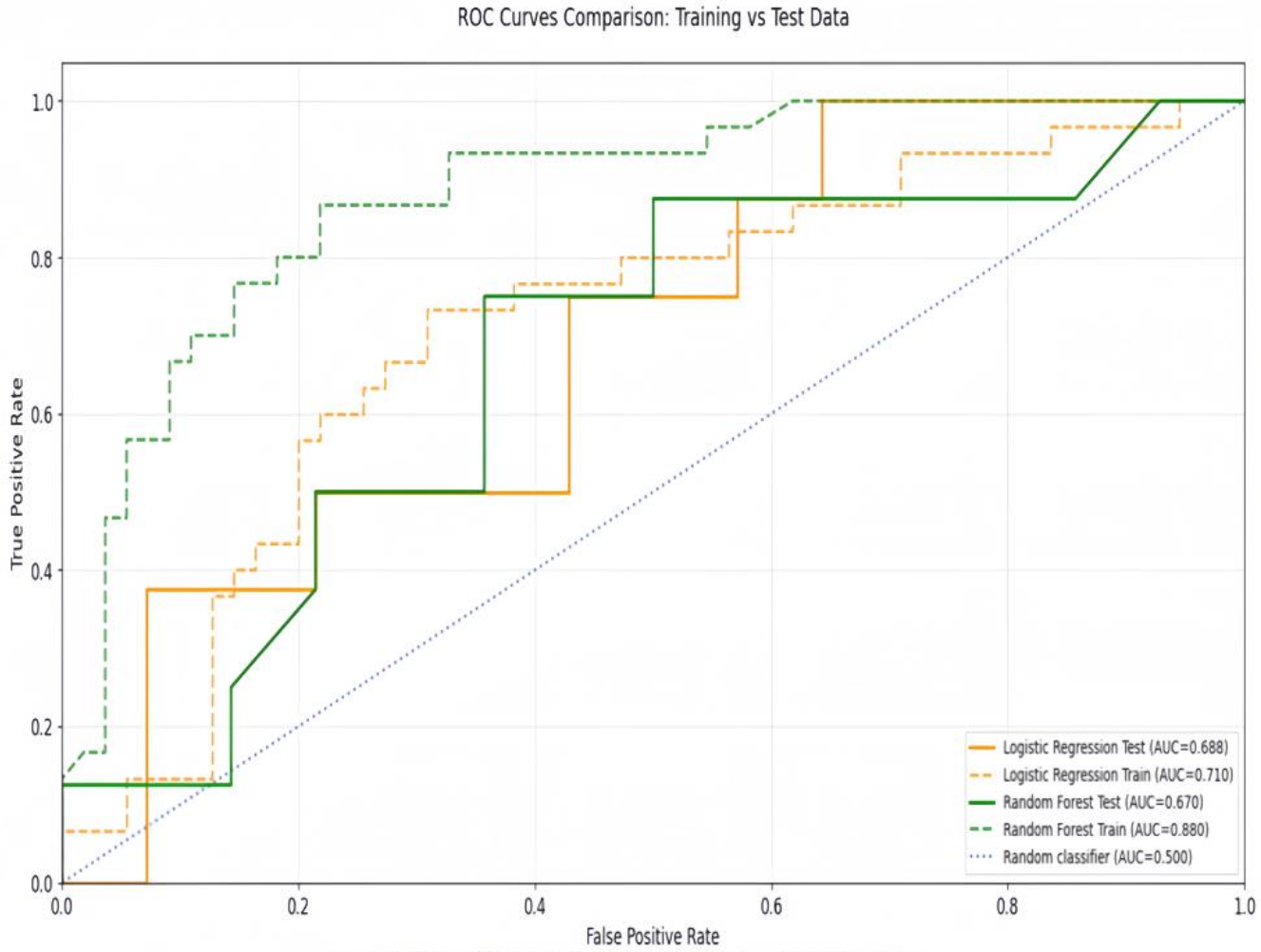

Figure 1: ROC Curves Comparison for Radiation-Induced Necrosis Prediction Models

Conclusion:

We developed and validated predictive models for RN risk after SRS. The models, particularly logistic regression with its high sensitivity and lower variance in performance metrics, demonstrate stable performance, making them valuable for clinical risk stratification. Future work includes cohort expansion and integration of radiomic features.

PP-062

E-Poster Viewing
SRS – BRAIN METASTASES

SMART (TROG 23.02): A MULTI-CENTRE PROSPECTIVE TRIAL OF SINGLE AND MULTI-FRACTION PREOPERATIVE RADIOSURGERY FOR BRAIN METASTASES

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Background: Preoperative radiosurgery (PreOp-SRS) for brain metastases (BM) is increasingly utilised supported by large multi-institution retrospective and prospective non-randomised reports with results from phase III trials awaited. Most of the prospective protocols and reported data involves single fraction PreOp-SRS. Retrospective results suggest that multi fraction PreOp-SRS may have some benefits compared with single fraction PreOp-SRS

Objective: The study will prospectively analyse outcomes from single and multi fraction PreOp-SRS for BM in a randomised fashion evaluating if multi fraction PreOp-SRS results in higher cavity local control (LC) rates than single fraction PreOp-SRS

Patients & Methods : SMART is a multi-centre randomised phase II prospective clinical trial (HREC/120590/PMCC). Patients with primary solid cancer diagnosis and radiologically confirmed BM who have been recommended surgery for up to two BM will be eligible. Exclusion criteria include lesion > 4cm, symptoms mandating emergency surgery, prior whole brain radiotherapy, SRS to the index BM(s) or presence of leptomeningeal disease (LMD). 73 eligible patients will be randomised to single fraction (15-20 Gy) or 3 fraction (24 or 27 Gy) PreOp-SRS followed by resection of the BM ideally within 7 days up to maximum of 14 days after SRS. All patients will undergo Magnetic Resonance Imaging (MRI) of the brain within 1-3 days after surgery then reviewed clinically and with MRI 3 monthly for 12 months. A 2:1 randomisation will be performed using the method of minimisation to optimise balance between the stratification factors and desired allocation ratio. Primary endpoint will be measured as cavity LC at 12 months after surgery. Secondary endpoints include overall survival, neurological death, LMD, adverse events and QOL.

Conclusion: PreOp-SRS is increasingly utilised however evidence for the most optimal fractionation schedule from prospective randomised trials is lacking. Funding has been secured allowing the opening of the study at three Australien centres in early 2026.

PP-063

E-Poster Viewing
SRS – BRAIN METASTASES

IMPACT OF TUMOUR DISTANCE FROM ISOCENTRE ON LOCAL CONTROL IN FRAMELESS SINGLE-ISOCENTRE SRS FOR MULTIPLE BRAIN METASTASES

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Aim To evaluate the impact of the distance between treatment isocentre and brain metastases (BM) on local failure in patients treated with frameless single-isocentre dynamic conformal arc stereotactic radiosurgery (SRS) using a 0mm PTV margin for multiple (≥4) BM.

Methods and materials All patients who underwent single-isocentre, multiple-target (SIMT) dynamic conformal arc SRS for ≥4 BM at Chris O'Brien Lifehouse between January 2018 and December 2019 were included in this retrospective study. Treatment planning was performed in Brainlab Elements, using a 0mm GTV to PTV margin and a single fraction for all lesions. Local recurrence-free survival was analysed in relation to the distance between each metastasis and the treatment isocentre. Univariate logistic regression analysis was performed to assess associations between local failure and potential predictors including distance from isocentre, PTV volume, prescribed dose and maximum dose relative to prescription.

Results Thirty-four patients with a cumulative number of 232 BM were included. Median follow-up after SIMT SRS was 16.5 months (range 0.7–48.1 months). In 18 of 34 patients (53%), each treatment plan included 6 or more BM. The most common prescribed single-fraction dose was 20 Gy (145/232; 63%) and the median PTV volume was 0.16 cm^3 (range 0.015 – 19.3 cm^3). The median distance from isocentre was 4.3 cm (range 0.5–9.2 cm). Local recurrence occurred in 27 lesions (11.6%), with a median local recurrence-free survival of 17.3 months (95% confidence interval 15.8–18.1 months). On univariate analysis, local recurrence was not associated with distance from isocentre (p=0.6), PTV volume (p>0.9), prescribed dose (p=0.4) or maximum dose relation (%) (p=0.3).

Conclusion Frameless single-isocentre SRS using dynamic conformal arcs for ≥4 BMs treated with a 0mm PTV margin achieved high local control irrespective of distance to the isocentre, supporting the use of this approach for patients with multiple intracranial targets.

PP-064

E-Poster Viewing
SRS – BRAIN METASTASES

GAMMA KNIFE RADIOSURGERY FOR NUMEROUS BRAIN METASTASES

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Objective:
This study evaluated the usefulness of Gamma Knife radiosurgery (GKRS) for numerous brain metastases. Although whole-brain radiotherapy (WBRT) is generally considered the standard treatment for patients with 50 or more metastatic lesions, we have adopted a treatment strategy aiming to avoid the risks and patient burden associated with WBRT by performing GKRS alone, even in cases with numerous metastases.

Methods:
For patients with numerous lesions, we initially treated 20–40 targets with GKRS and re-evaluated with MRI after 1–2 months to determine the need for additional GKRS. To date, 12 patients with numerous brain metastases have been treated according to this protocol.

Results:
The primary cancers included lung cancer (n=5), breast cancer (n=4), colorectal cancer (n=1), renal cell carcinoma (n=1), and uterine cancer (n=1). One patient had previously undergone WBRT. The number of intracranial lesions ranged from 50–100 in 8 patients, and exceeded 100 in 4 patients. The prescribed dose was 18–20 Gy (median: 20 Gy). Survival after the first GKRS session ranged from 3 to 29 months (median: 12 months), and survival after diagnosis and initial treatment of numerous metastases ranged from 1 to 24 months (median: 6 months).

Conclusion:
Two major factors support the usefulness of this treatment approach. First, the bystander effect may allow for immunologic tumor control even in lesions that are not directly irradiated. Second, combining GKRS with systemic therapies such as immune checkpoint inhibitors and tyrosine kinase inhibitors may further enhance intracranial disease control. These findings suggest that GKRS alone can be a beneficial treatment option for patients with numerous brain metastases.

PP-065

E-Poster Viewing
SRS – BRAIN METASTASES

TRENDS IN CRANIAL RADIOTHERAPY: A SINGLE-INSTITUTION EXPERIENCE HIGHLIGHTING THE ROLE OF STEREOTACTIC RADIOSURGERY

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Brain metastases are the most common intracranial tumors and are a major cause of cancer-related neurological morbidity and mortality. Improvements in neuroimaging have led to earlier detection of limited intracranial disease, thereby increasing the use of stereotactic radiosurgery (SRS) and fractionated SRS (fSRS) in appropriately selected patients.

Aim: To evaluate the demographic and clinical characteristics of patients receiving cranial radiotherapy at our institution, with emphasis on those treated using SRS or fSRS.

Methods: We performed a retrospective analysis of patients who received cranial radiation therapy (RT) for either primary brain tumors or brain metastases between February 2019 and July 2025. A predefined subgroup of patients treated with SRS or fSRS was analyzed in greater detail. Data collected included patient demographics, tumor histology, treatment intent, radiotherapy technique, and prescribed dose and fractionation.

Results: During the study period, 5,635 patients received RT at our center, of whom 323 (5.7%) underwent cranial irradiation. Of these, 113 patients(2.0%) were treated for primary brain tumors and 210 (3.7%) for brain metastases. Volumetric modulated arc therapy (VMAT) was the most commonly employed technique, used in 82% of cases.The SRS/fSRS subgroup comprised 49 patients with a total of 56 treated lesions. Metastatic lesions accounted for 90% of cases, while 10% were benign intracranial tumors. Lung carcinoma was the most frequent primary malignancy (34.7%), followed by breast carcinoma (22.4%). Most lesions were located in the supratentorial compartment (63.3%). Single-fraction SRS (12–25 Gy) was delivered in 57.1% of patients, while 30.6% received fSRS (24–50 Gy in 3–5 fractions). A combination of SRS and fSRS for multiple lesions was used in 12.2% of patients.

Conclusion: This institutional audit demonstrates contemporary patterns in the use of cranial radiotherapy, with brain metastases—predominantly from lung and breast primaries—remaining the leading indication. The high utilization of VMAT-based approaches and SRS/fSRS reflects an increasing emphasis on precision radiotherapy in routine neuro-oncology practice.

PP-066

E-Poster Viewing
SRS – BRAIN METASTASES

THE USEFULNESS OF STEREOTACTIC FRACTIONATED RADIOTHERAPY USING GAMMA KNIFE ICON MASK SYSTEM FOR RELATIVELY LARGE BRAINSTEM METASTASES.

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Objective: The effectiveness of stereotactic radiosurgery for brainstem metastases has already been demonstrated, but issues remain regarding local control in the long term and the volume limit of the target. Since the introduction of the Gamma Knife Icon, it has also become possible to perform fractionation with mask fixation. Therefore, we investigated the treatment outcomes of brainstem metastases exceeding 1 mL, among the cases in which stereotactic fractionated radiotherapy (SRT) was performed at our hospital.

Methods: We investigated 35 cases and 38 sessions using Icon SRT, including brainstem metastases exceeding 1 mL. The sites were 15 of midbrain, 19 of pons, and 1 case of medulla oblongata. The most common primary tumor was lung in 17, followed by breast in 10, gastro-intestinal tracts in 6, and other in 2 cases. The median volume of brainstem lesions was 3.1 mL. Brainstem lesions were the largest lesions in 22 cases. There were 33 cases of 10 fractions, 2 cases of 5 fractions, and 2 cases of 6 fractions. The median dose per fraction for 10 fractions was 3.7/6.4 Gy.

Results: The median survival time after SRT was 11.9 months, and the incidence of neurological death was 6/12/24/36 months was 11/15/19/26%. Local control failure was 8/17/17/17% at 6/12/24/36 months, and quality of life was maintained in 87/78/72/69% at 6/12/24/36 months, with no serious complications.

Conclusions: SRT is suggested to be an effective treatment for medium-sized to relatively large brainstem metastases, including functional prognosis.

PP-067

E-Poster Viewing
SRS – BRAIN METASTASES

TREATMENT OUTCOME OF STEREOTACTIC RADIOSURGERY IN THE SMALL AND MEDIUM-SIZED CYSTIC METASTATIC BRAIN TUMORS

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Purpose We investigated the outcomes of SRS in small and medium-sized cystic METs and evaluated whether their tumor control differs from that of METs with other radiological patterns.

Materials and Methods The mean patient age was 64.7 years; 58 were male and 29 were female. None had undergone previous local brain treatment. Primary cancer types included non-small cell lung cancer (n = 69), small cell lung cancer (n = 22), breast cancer (n = 10), and others (n = 10). At the time of Gamma Knife radiosurgery (GKRS), the mean tumor volume was 4.28 cc (range, 0.08–18.28 cc), and the median prescribed margin dose was 20 Gy (range, 14–25 Gy). The volume of the cystic component ranged from 0.02 to 7.76 cc (mean 1.28 cc, median 0.64 cc). The proportion of cystic content ranged from 5.68% to 63.96% (mean 26.34%, median 25.54%).

Results A total of 111 tumors treated with GKRS as the initial local treatment were included in the statistical analysis. The overall tumor control rate was 70.2% (78/111), and the mean and median progression-free survival (PFS) were 362 days and 210 days, respectively. Kaplan–Meier analysis showed significantly better tumor control in small tumors (<5 cc) compared with larger tumors (≥5 cc) ($p = 0.022$), whereas the 10-cc cutoff was not significant ($p = 0.503$). A prescribed dose ≥18 Gy was significantly associated with better tumor control ($p = 0.025$), but a higher cutoff of ≥20 Gy was not ($p = 0.184$). Interestingly, early dramatic tumor shrinkage after SRS was not associated with final tumor control ($p = 0.116$). The proportion of the cystic component also showed no significant relationship with tumor control ($p = 0.530$).

Conclusion Small and medium-sized cystic METs treated with SRS demonstrated tumor control rates comparable to, or slightly lower than, those reported for general METs.

PP-068

E-Poster Viewing
SRS – BRAIN METASTASES

TREATMENT OUTCOME OF STEREOTACTIC RADIOSURGERY FOR METASTATIC BRAIN TUMORS FROM SQUAMOUS CELL LUNG CANCER

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Purpose We retrospectively evaluated LSQC patients with BM who were treated primarily with stereotactic radiosurgery (SRS). Our goal was to assess tumor control following SRS and identify prognostic factors associated with treatment outcomes.

Materials and Methods Over the past 17 years, 134 patients with pathologically confirmed LSQC and brain metastasis underwent Gamma Knife radiosurgery (GKRS). The mean age was 65.9 years; 123 were male and 11 were female. Sixty-nine patients had a single metastasis, while 65 had multiple lesions. A total of 211 tumors were treated in these 134 patients. The mean tumor volume at the time of GKRS was 3.41 cc (range, 0.1–64.48 cc), and the median prescribed marginal dose was 20.3 Gy (range, 14–25 Gy).

Results During follow-up, 82 patients (61.2%) with 187 tumors underwent serial MRI evaluations. Among these tumors, the mean volume at GKRS was 3.295 cc, and the mean prescription dose remained 20 Gy. Three patients received two-fraction GKRS. The tumor control rate was 80.2% (146/182). The mean and median progression-free survival (PFS) were 182 and 153 days, respectively. Kaplan–Meier analysis revealed significantly superior tumor control in small tumors (<5 cc) compared with large tumors (≥5 cc) ($p = 0.018$). A 10-cc cutoff was also statistically significant ($p = 0.046$). A prescription dose ≥20 Gy was not associated with improved tumor control ($p = 0.237$). Metachronous metastasis demonstrated better tumor control than synchronous metastasis ($p = 0.008$). Concurrent systemic therapy at the time of GKRS was significantly associated with tumor control ($p = 0.001$). Among the 82 patients, the overall mean and median survival after GKRS were 417 and 288 days, respectively.

Conclusion Although LSQC generally exhibits more aggressive behavior compared with other NSCLC subtypes, SRS appears to play a meaningful and effective role in the management of LSQC patients with brain metastasis.

PP-069

E-Poster Viewing
SRS – BRAIN METASTASES

CHECKING MULTI-MET LESIONS WITH IMAGING VARIATION METHOD FOR BRAIN STEREOTACTIC RADIOSURGERY (SRS)

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Introduction: Outcome prediction is an expectation with following up imaging information. There are several methods such as visual review, volume check and so on. In this analysis, an image perturbation method was employed to analyze and distinguish the stereotactic radiosurgery effect for a multi-met lesion.

Methods and materials: A patient with 18 lesions were selected for this study, the temporal points were 8 for about two years, and the data included Magnetic Resonance (MR) image set, simulation Computed Tomography (CT) image set, Cone Beam Computed Tomography (CBCT) image set. Through registration process, the target delineation was transferred to the new temporal point image set. The variations were expressed with target pixel Hounsfield Unit(HU) perturbation. After nondimensionalizing of this 8x18 matrix, the vertical matrix elements formed a set of numerical arrays. The similarity of these array sets was compared with ranking method.

Results: The initial characteristics of these lesions in average volume was 0.16cc with diameters at 0.33cm. The pixel Hounsfield Unit was 19, 156, and 44 in minimum, maximum and mean. For the standard deviation of the HU in these volumes were 22, 144, 163, 21, 185, 27, 68 and 29 at the temporal sequence for this study, and the corresponding imaging modalities were CT, MR, MR, CT, MR, CBCT, MR and CT. When referring to initial treatment data set for these lesions, the P values for these temporal points were 0.002, 0.003, 0.609, 0.002, 0.002, 0.006 and 0.002 with paired assumption.

Conclusion and discussions: This study analyzed the local radiosurgery treatment effect with different image modalities based on pixel HU number perturbation. Further improvement of this analysis should include temporal point spans evenness, brain tissue structure with geometry location, the homogeneity of dose distribution and treatment machine mechanical limitation due to the small scales of the multi-metastases lesions.

PP-070

E-Poster Viewing
SRS – BRAIN METASTASES

DOSE, TARGETS, OARS FOR BRAIN RADIOSURGERY WITH PREVIOUS TREATMENTS BY VARIOUS MODALITIES AT DIFFERENT HOSPITALS

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We report on our experience on how to co-register images, structures/contours of targets and organs at risk (OARs), and dose from different radiation modalities for brain patients treated with multiple radiation therapies/radiosurgeries at the same or different hospitals for planning a new radiosurgery. With the emergence of various radiation modalities available for stereotactic radiosurgery, the chances for brain patients with metastatic lesions or other diseases being treated by different modalities of radiation therapy at different hospitals are increasing. A patient could be treated for brain metastatic lesions with Linac-based SBRT, and then the newly occurring lesions might be treated with Gamma Knife, CyberKnife, Proton Therapy, or other modalities at the same or different hospitals. While the availability of various radiosurgery modalities offers more options for patients to be treated with the optimal treatment modality, it also brings the challenge of merging the previous treatment plans from different treatment platforms/modalities at the same or different hospitals to identify correct targets and prescribe the right dose for the new treatment. There is a need for developing a good strategy and an efficient clinical flow for planning new radiosurgery treatments. At our hospital, we have Gamma Knife, Varian TrueBeam Linacs, and Proton Therapy available for brain treatments. Often, a patient is treated across different modalities, and sometimes a patient even has been treated at other hospitals and now is referred to our hospital for a new treatment. We have built up systematic strategies and workflow to perform radiosurgery for these patients by using commercial software MIM to communicate between image servers to handle different treatment modalities. We will introduce our experience in this area and how we carry out the strategies in clinical practice, starting from import/exporting images from different platforms/modalities to co-registration of images, structures, and dose and finally to treatment planning.

PP-071

E-Poster Viewing
SRS – BRAIN METASTASES

REVIEW OF THE FIRST 1000 PATIENTS TREATED WITH GAMMA KNIFE AT THE PETER MAC CALLUM CANCER CENTRE

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Introduction: Gamma Knife Stereotactic Radiosurgery (GK-SRS) is a non-invasive, high-precision treatment for various intracranial pathologies, including benign and malignant tumours, vascular malformations, and functional disorders. Our review examines the first 1000 patients treated in a large Victorian cancer centre.

Methods: This study presents a retrospective review of the first 1000 consecutive patients treated with GK-SRS at a single institution in Melbourne, Australia. Patients were treated across a 4-year period (2021-2025). Patient demographics, clinical indications, number of treatments, and treatment approaches were meticulously collected for an observational review of the first 1000 patients treated.

Results: The cohort included 1000 patients undergoing 1220 treatments on the Gamma Knife Icon®. Eight hundred and thirty-nine (839) patients received just one course of treatment, and the remaining 161 patients received two or more. Of these patients, 71% were treated for malignant disease and the remaining 29% were treated for benign conditions. The most commonly treated cancers were from lung cancer, followed by melanoma and breast cancer. The most common benign conditions were vestibular schwannoma, meningioma and AVM. Eighty-one percent (81%) of patients were treated using the mask-based treatment, while 19% were treated using a frame.

Conclusion: This large, single-centre experience from a large metropolitan cancer centre demonstrates a different casemix compared to other Australian and international Gamma Knife centres. Our workload included 71% malignant disease and 29% benign conditions. Possible reasons for this difference include statewide referral patterns, clinician decision-making, government funding models, and geographic accessibility. This information may help to inform future cancer service provision within Australia.

PP-072

E-Poster Viewing
SRS – BRAIN METASTASES

REAL-WORLD CYBER-SPACE: REPEAT LINAC-BASED SRS FOR HIGH-VELOCITY MULTIPLE BRAIN METASTASES

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PURPOSE: To report real-world implementation of the CYBER-SPACE surveillance-and-salvage paradigm in a high brain metastasis velocity (BMV) phenotype requiring 32- and 20-lesion SRS courses, yet with low cumulative intracranial tumor volume enabling whole-brain radiotherapy (WBRT) deferral.

METHODS: Serial single-fraction VMAT SRS courses (Sep 2022–Jun 2025) were delivered in one patient with metastatic lung adenocarcinoma. Planning MRI was obtained within 7 days prior to each SRS; surveillance MRI was performed every 12 weeks. Response was described per RANO-BM; neurologic function per NANO. Primary endpoint was WBRT-free survival. WBRT stopping rules were radiographic leptomeningeal disease, >10 new/progressive metastases on a single surveillance MRI, or inability to meet normal-brain/organs-at-risk constraints with further SRS.

RESULTS: Five SRS courses treated 63 metastases (3/7/32/1/20) across Sep 2022/Feb 2023/Aug 2023/Feb 2024/Jun 2025 (inter-course interval 5–16 months; median 6). Lesions were predominantly subcentimeter (<10 mm); cumulative treated intracranial tumor volume was 20.71 cm^3. Dose was volume-adapted (20–22 Gy): 22 Gy in low-burden courses and 20 Gy for the 32- and 20-lesion courses. Despite two episodes meeting the >10-lesion WBRT consideration threshold, repeat SRS was delivered and WBRT avoided. Best intracranial response was complete/partial (RANO-BM). One metastasis treated in 2023 progressed locally and underwent repeat SRS in 2025 with radiographic control on Dec 2025 MRI. No radiographic or symptomatic radionecrosis occurred and NANO remained 0 at last follow-up (Dec 2025). Extracranial L2 oligoprogression (Jul 2025) was treated with SBRT 24 Gy in 2 fractions. WBRT was not delivered (WBRT-free survival 39 months).

CONCLUSIONS: Serial, volume-adapted VMAT SRS with strict MRI surveillance and predefined escalation criteria can defer WBRT and preserve neurologic function despite high BMV when cumulative intracranial tumor volume is low.

PP-073

E-Poster Viewing
SRS – BRAIN METASTASES

FIRST REPORT OF STAGED ADAPTIVE FRAMELESS STEREOTACTIC RADIOSURGERY IN 3 "PULSES" TO SALVAGE BRAIN METASTASES THAT FAILED PRIOR RADIOSURGERY

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Background Staged stereotactic radiosurgery (SRS) for brain metastases takes advantage of longer intervals between fractions to reduce treatment-related side effects while maintaining effectiveness. We report our approach for frameless staged SRS consisting of 3 fractions of 8Gy, 8Gy and 4Gy every 2 weeks as salvage re-irradiation of brain metastases that progressed after prior SRS.

Methods Patients treated with frameless staged SRS for both intact and post-operative metastases were identified from our institutional database. Only metastases that failed previous SRS were included. The primary outcome was the rate of radiation necrosis (RN), and secondary outcomes included local failure (LF) and overall survival (OS). Outcomes were calculated using Kaplan-Meier or competing-risks methods. Cox regression as well as Fine-Gray competing-risks regression were used to identify factors associated with RN, LF and OS.

Results Fifty patients with 89 metastases were treated with staged SRS. The majority were breast (34.8%) and lung (41.6%) cancer patients. Seventy-seven (86.5%) lesions were intact, and twenty (22.5%) were from radioresistant primaries. Median follow-up was 9.6 months. RN rates were 6.8%, 12.4% and 13.8% at 6, 12 and 18 months, respectively. At one year, 4 (4.5%) RN events were Grade 1 or 2, and 7 (7.9%) were Grade 3. LF and OS rates at 6, 12 and 18 months were 16.1%, 28%, 30.8%, and 81.6%, 60.4%, 42.3%, respectively. On regression analysis, maximum dose within the target lesion as a weighted average (HR=1.14 per additional Gy, p=0.048) predicted for RN. There was a trend towards worse LF in radioresistant lesions (HR= 2.09, p=0.078). A reduction in target volume was observed in 63% and 75% of all treated lesions between fractions 1 to 2 and 2 to 3, respectively.

Conclusions Our staged SRS regimen was an effective and well-tolerated adaptive treatment for re-irradiation of brain metastases with a favorable RN profile.

PP-074

E-Poster Viewing
SRS – BRAIN METASTASES

OUTCOMES IN LONG-TERM SURVIVORS TREATED WITH STEREOTACTIC CRANIAL RADIOTHERAPY FOR BRAIN METASTASES

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Purpose:
To evaluate clinical outcomes in long-term survivors treated with stereotactic cranial radiotherapy (SRT) for brain metastases, focusing on recurrence patterns and the incidence of radiation necrosis (RN).

Methods:
We retrospectively identified patients who received cranial radiotherapy for brain metastases between 2018 and 2024, coinciding with the widespread adoption of SRT in our department. Patients were included if radiological follow-up exceeded 104 weeks from first SRT. Treatment details, target characteristics, and patterns of failure or salvage therapy were assessed.

Results:
A total of 49 patients (30 female, 19 male) met the inclusion criteria, with a median follow-up of 31.3 months (range 24-100). Median age at first treatment was 64 years. The most common primary malignancies were NSCLC (n=25), breast cancer (n=8), and SCLC (n=6). Across 124 courses of radiotherapy, 232 brain metastases were treated (188 intact lesions, 30 resection cavities, 14 WBRT). The median number of courses per patient was 2 (range 1–10). 20 RN (9.3% of all lesions) developed in 18 patients, 10 were resection cavities (33.3% of all cavities) and 10 intact metastases (5.3%). Eight RN had received in-field re-irradiation. Median time from last RT to RN diagnosis was 13 months (range 1-55); 7 lesions were resected. In-field failure occurred in 34.7% of treatment courses, including 18.3% of SRT-treated targets. Most in-field recurrences (70.0%) were managed with re-irradiation. Median time to in-field recurrence was 14 months (range 2-85). Out-of-field cranial failure occurred after 45% of localized treatments. Nine patients (18.4%) experienced no cranial failure. Estimated median survival was 87 months (95% CI 79-95), 42 patients were still alive at last follow-up.

Conclusion:
Among long-term survivors with brain metastases treated using SRT, both local failure and RN remain significant risks. These findings highlight the ongoing challenge of balancing durable tumor control with treatment-related toxicity in this growing patient population.

PP-075

E-Poster Viewing
SRS – BRAIN METASTASES

PATTERNS OF SALVAGE RADIOTHERAPY AFTER STEREOTACTIC RADIOTHERAPY AND WHOLE-BRAIN RADIOTHERAPY FOR BRAIN METASTASES: A RETROSPECTIVE ANALYSIS

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Background:
Stereotactic radiotherapy (SRT) has become a widely accepted standard of care for brain metastases, offering improved local control with fewer cognitive side effects compared to whole-brain radiotherapy (WBRT). However, concerns persist regarding increased retreatment rates and eventual need for salvage WBRT. This study aims to evaluate the frequency, timing, and patterns of salvage cranial radiotherapy-particularly WBRT after SRT and SRT after WBRT.

Methods:
We retrospectively analyzed patients who received cranial radiotherapy for brain metastases between 2018 and 2024 at our institution. Patient characteristics, treatment modalities, fractionation schemes, and time intervals between treatments were assessed.

Results:
Out of 462 patients identified, 28 who received prophylactic WBRT only were excluded. The final cohort included 434 patients (most commonly NSCLC (n=199), SCLC (n=67), and breast cancer (n=58)), who received 594 courses of cranial radiotherapy. SRT was the initial treatment in 237 patients, of whom of whom 80 patients (31%) received at least one further course of cranial RT after a median of 7.6 months (range 1.2-60.9). 20 patients (7.8%) required salvage WBRT. The median time from first SRT to salvage WBRT was 6.6 months (range 1.2-59.1). Conversely, among 172 patients initially treated with WBRT, 17 (9.9%) required salvage SRT at a median of 12.4 months (range 3.3-62.8). An additional four patients underwent salvage SRT after prophylactic WBRT. Overall, 101 patients (23.3%) received more than one course of cranial RT, with 36 undergoing three or more courses.

Conclusion:
The rate of salvage WBRT after upfront SRT was low (7.8%) and comparable to the rate of salvage SRT after WBRT (9.9%). However, the timing of salvage interventions differed, with WBRT occurring sooner after initial SRT compared to the later need for SRT post-WBRT. These findings support the continued use of SRT as a first-line treatment, given the relatively low requirement for salvage WBRT.

PP-076

E-Poster Viewing
SRS – BRAIN METASTASES

FRACTIONATED SRT FOR BRAIN METASTASES WITH LARGE CUMULATIVE VOLUME: DATA FROM A SINGLE INSTITUTION 5-YEAR COHORT

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Stereotactic radiotherapy (SRT) in 3-5 fractions is increasingly being used for patients with large numbers of multiple brain metastases. However, reported data on outcomes for patients with large cumulative target volumes remains limited, with recommended radiotherapy pathways for patients with large number of metastases and/or cumulative volume being whole brain radiotherapy or decision not to treat. We retrospectively reviewed 55 patients treated for brain metastases by linear-accelerator based SRT over a 5-year period from 2020-2025, all with cumulative target volumes >20 cc. 13 patients were excluded in final analysis, being lost to follow up, or having not yet reached < 6 months post-treatment. For the 42 remaining patients, the median number of targets per patient was 4 (range: 1–35), including both intact metastases and resection cavity targets. Fractionation schedules included were 25 or 30 Gy in 5 fractions (n=34), and 27 Gy in 3 fractions (n=8). For 3 fraction treatments, median V20 was 50.1cc (range: 15.1- 97.4), while for 5 fraction treatments, median V24 was 47.8 cc (range 25.4 to 218.5). Median cumulative target volume was 35.2 cc (range: 20.4 – 91.5 cc). Six patients had a previous intracranial SRT treatment; the remainder were first-course SRT. Interim data for median overall survival from the start date of radiotherapy was 9.0 months. Our data suggests that for patients with brain metastases, large cumulative intracranial target volumes are not necessarily a relevant prognostic factor for patient survival, and triage decisions assuming a very short survival period may require reconsideration, with need for further multi-institutional publication data from centres who treat large cumulative metastatic volumes.

PP-077

E-Poster Viewing
SRS – BRAIN METASTASES

COMPARATIVE DOSIMETRIC AND CLINICAL EVALUATION OF GAMMA KNIFE AND VERSA HD SRS FOR MULTIPLE BRAIN METASTASES

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Purpose/Objective:
This study compares two stereotactic radiosurgery (SRS) treatment pathways for brain metastases: Gamma Knife (GK) Icon using TMR-based dose calculation and zero margin, and Versa HD linac-based SRS planned in Elements with VMAT or dynamic conformal arcs and ExacTrac positioning. Both dosimetric plan characteristics and clinical outcomes were evaluated to assess differences in treatment delivery, plan quality, and patient response.

Materials/Methods:
GK plans were generated in GammaPlan using prescription doses of 18–24 Gy delivered to prescription isodose lines (IDL) between 40–97%. Versa HD plans used Monte Carlo dose calculation with 1–1.5 mm PTV margins depending on lesion distance from isocenter, and IDLs typically ranging from 75–85%. The cohort comprised 45 GK patients (181 metastases) and 43 Versa patients (115 metastases). Planning metrics included GTV volume, V12, GTV mean dose, conformity index (CI), and gradient index (GI). Clinical endpoints included neurotoxicity, radionecrosis (RN), local failure (LF), distant brain failure, time to LF, concurrent systemic therapy, and salvage treatment.

Results/Conclusions:
Mean GTV and V12 were smaller for GK plans (0.35 cc and 0.89 cc) than for Versa (1.39 cc and 4.67 cc). The V12–GTV relationship was steeper for Versa (V12 = 1.74·vol + 2.49) than for GK (1.48·vol + 0.38), reflecting greater dose spill in linac-based plans. CI and GI also differed between systems, with GK showing higher median CI and broader variability, while GI medians were similar but with a wider range for GK. GK demonstrated dosimetric and toxicity advantages in this cohort, particularly for small metastases, including substantially lower V12 volumes and a lower observed radionecrosis rate (18.2% vs 25.0%). These differences reflect GK's sharper dose fall-off and marginless planning. Local failure rates were comparable (GK 9.1%, Versa 8.3%), with a median time to LF of approximately 7 months. Further work with complete clinical datasets is warranted.

PP-078

E-Poster Viewing
SRS – BRAIN METASTASES

LONG-TERM SAFETY AND EFFICACY OF STAGED STEREOTACTIC RADIOSURGERY WITH OMMAYA RESERVOIR ASPIRATION FOR LARGE CYSTIC BRAIN METASTASES:

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Objective:
Managing large cystic brain metastases (BMs) remains challenging. This study evaluated the feasibility and outcomes of cyst aspiration via an Ommaya reservoir followed by staged stereotactic radiosurgery (SRS) for large cystic BMs.

Methods:
We retrospectively analyzed patients with large cystic BMs that remained ≥10 mL after aspiration and/or were located in the primary motor cortex, who underwent staged SRS at a tertiary cancer center. The protocol delivered 20–30 Gy in two fractions, three weeks apart. Outcomes included overall survival (OS), local control, and leptomeningeal metastases (LMs), with competing-risk analysis where appropriate.

Results:
Thirty-two patients with 34 large cystic BMs were included. The median age was 71 years, and 20 patients (63%) were male. Primary cancers included lung (20), breast (5), genitourinary (4), gastrointestinal (2), and melanoma (1). The median tumor volume (TV) before treatment was 34.1 mL (IQR 22.9–53.8). Median TV reduction rates at the first and second SRS sessions, relative to the intact cystic BMs, were 62% (IQR 42–73) and 82% (IQR 66–87). The 1- and 2-year OS rates were 49% and 36%, with a median survival of 8.3 months. Concurrent targeted therapy (TT) and/or immunotherapy (IT) was the only independent factor associated with improved OS (HR 0.31, 95% CI 0.11–0.88, P = 0.027). The 1- and 2-year local failure rates were 20% and 37%, and LM rates were 13% and 26%. One serious adverse event, likely due to ventricular violation by the catheter tip, led to diffuse LMs.
Conclusions:
Cyst aspiration via an Ommaya reservoir followed by staged SRS is a feasible and minimally invasive option for large cystic BMs. The addition of TT and IT may improve survival. However, long-term disease control remains challenging, emphasizing the need for further strategies to enhance OS, improve local control, and prevent LMs.

PP-079

E-Poster Viewing
SRS – BRAIN METASTASES

FEASIBILITY STUDY OF A 3-DIMENSIONAL DOSIMETRY PHANTOM FOR LEKSELL GAMMA KNIFE PERFEXION

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Purpose: The purpose of our study is to develop a method of verifying the 3-D dosimetric configuration of the collimated sources using a phosphor screen with a CCD camera in the Leksell Gamma Knife-Perfexion.

Methods: The instrument consists of a moving head phantom, an embedded thin active layer and a CCD camera system and was designed to be mounted to LGKP. The system consists of a intensifying screen (Gd2O2S:Tb), CCD camera (VA-2MG-42,Syncron Corp, Korea), Lens, Hemispherical phantom (diameter 16cm, PMMA material), system controller board, step motor to moving the system and control PC. The system based on CCD camera can be measurements of 2D light output with a large dynamic range. The center of HP was mounted at the isocenter with its axis aligned along the longitudinal(Z)-axis of the couch. the backscatter plate was placed the inside of HP for the additional backscatter compensating. The intensifying screen was placed between the HP and backscatter plate. The scan image was obtained each collimator size, and the exposure time was 0.5s to all positions. Using the system, 300 images with 0.2 mm slice gap were acquired under three collimator setups (4mm, 8mm and 16mm), respectively. The 2D projected doses from the 3D distributions of the CCD doses were compared with the irradiated film dose.

Results: As all doses normalized by the maximum dose value in 16 mm setup, the relative differences between the equipment dose and film dose were 0.2% for 4mm collimator and 0.5% for 8mm. The acquisition of 300 images by the equipment took less than 3 minutes.

Conclusions: The new equipment was verified to be a good substitute to radiochromic film, with which required more time and resources. Especially, the new methods was considered to provide much convenient and faster solution in the 3D dose acquisition for LGKP.

PP-080

E-Poster Viewing
SRS – GLIOMAS & OTHER PRIMARY BRAIN TUMORS

GAMMA KNIFE RADIOSURGERY FOR THE UVEAL MELANOMA: PRELIMINARY ASSESSMENT AT CHO RAY HOSPITAL

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Abstract Objectives: To report early treatment results and complications of stereotactic radiosurgery in uveal malignant melanoma and to identify risk factors for development of radiation retinopathy.

Materials and Methods: This was a study of 5 patients diagnosed with uveal melanoma between 2023 and 2025. Best corrected visual acuity, funduscopic findings, basal tumor diameter and tumor thickness were recorded at baseline and at follow-up visits at 3-month intervals. The response of tumors to stereotactic radiosurgery and complications were determined.

Results: The mean basal diameter of tumor was 13,96 ± 1,98 (11,9 – 17) mm, tumor thickness was 5,94 ± 1,84 (3,9 – 7,7) mm at baseline. The mean dose was 16,8 ± 1,79 (16 -20) Gy. The mean isodose was 96,2 ± 5,84 (86 - 100). The mean visual acuity was 0,5 ± 0,3 (0,6 - 0,2) logMAR before treatment and 0,4 ± 0,2 (0,4 – 2) after the mean follow-up period. The longest follow-up period case was 24 months, and the shortest just one month. The tumor completely disappeared four months after the first GKRS. The other cases had good outcomes withs no further complications.

Conclusion: Our short-term results show stereotactic radiosurgery was an effective and sustained treatment modality among the other eye conservation therapies. A larger, long – term study is required and good cooperation is needed among the specialties of ophthalmology, oncology and Gamma Knife radiosurgery/neurosurgery specialists.

PP-081

E-Poster Viewing
SRS – GLIOMAS & OTHER PRIMARY BRAIN TUMORS

RADIOSURGICAL TREATMENT OF GLIOBLASTOMA RECURRENCES

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Abstract Body Summary: Despite combined treatment conducted according to modern standards, glioblastoma recurrences develop in most cases within a few months after primary resection, which accounts for the low progression-free and overall survival (OS) rates in this pathology. One of the most effective methods used in the progression of malignant gliomas is repeat radiation therapy, the indications for which have expanded after the introduction of stereotactic irradiation into routine clinical practice.

Aim of the study: To evaluate the results of using a radiosurgical (RS) approach in the treatment of glioblastoma relapses and to identify factors determining its effectiveness.

Materials and methods: From 2005 to 2024, RS treatment was performed on 168 patients with glioblastoma recurrences, of which 88 patients with 180 foci of local and distant progression were included in this study. The average age of patients was 42.8 ± 2.1 years (4–73 years). The mean time to RS irradiation after combine treatment include surgery and chemo-radiotherapy was 12.7 months. The mean volume was 2.4 cm^3. The mean dose was 20 Gy. The median follow-up time after RS was 11.2 months. All patients had systemic therapy after RS.

Result: Performing re-irradiation alongside adjustment of systemic therapy allowed for an increase in progression-free survival (PFS) and OS with minimal radiation toxicity. The one-year OS was 62.2%; the median OS after recurrence detection was 14.7 months. Significant factors for the best local control were a marginal dose 18 Gy and a distant location of the recurrence. The median PFS in patients with distant progression of glioblastoma was 3.6 months compared to 9.1 months in patients with local recurrence.

Conclusions: Re-irradiation using a radiosurgery regimen with a dose 18 Gy and higher in cases of glioblastoma progression is an effective local treatment option, allowing for an increase in progression-free survival and overall survival rates.

PP-082

E-Poster Viewing
SRS – GLIOMAS & OTHER PRIMARY BRAIN TUMORS

STEREOTACTIC RADIOSURGERY FOR PILOCYTIC ASTROCYTOMA: A SINGLE CENTER RETROSPECTIVE STUDY

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Introduction Pilocytic astrocytoma (PA) is a WHO grade I glioma with generally favorable outcomes; however, deep or eloquent tumor locations often limit safe gross total resection. Gamma Knife radiosurgery (GKRS) has emerged as a minimally invasive alternative for residual or recurrent disease.

Research Questions: Which clinical, radiological, or treatment-related variables independently predict recurrence risk following GKRS?

Materials and Methods A retrospective review of 88 patients treated with GKRS between 2008–2024 was conducted. Clinical, radiological, and treatment parameters were analyzed. PFS was assessed with Kaplan–Meier analysis, and predictive factors were identified using univariate and multivariate Cox regression models.

Results Median follow-up was 36 months. Pediatric patients showed 5- and 10-year PFS rates of 84.7% and 66.7%, while adults demonstrated 81.7% at both time points. Multivariate analysis identified prior radiotherapy as the only independent predictor of recurrence in the entire cohort, with significant impact also observed in the pediatric subgroup. Cystic/mixed morphology increased recurrence risk in pediatric patients, while no independent predictors were identified in adults.

Discussion and Conclusion GKRS provides durable long-term tumor control in both pediatric and adult PA patients. Prior radiotherapy consistently predicts poorer PFS, underscoring its importance in treatment planning. In pediatric patients, tumor morphology also influences outcomes. Despite the retrospective design and cohort heterogeneity, this represents one of the largest single-center GKRS series and supports GKRS as a safe and effective modality for PA management. Prospective studies are needed to refine patient selection and optimize therapeutic strategies.

PP-083

E-Poster Viewing
SRS – GLIOMAS & OTHER PRIMARY BRAIN TUMORS

RETROSPECTIVE STUDY OF LONG-TERM TUMOR CONTROL AND QUALITY OF LIFE IN LOW-GRADE GLIOMA PATIENTS TREATED WITH GAMMA KNIFE RADIOSURGERY.

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Objective:
Surgical resection is the standard initial treatment for low-grade gliomas (LGGs), with radiotherapy and chemotherapy used selectively. Gamma Knife radiosurgery (GKRS) has emerged as a minimally invasive alternative aiming to achieve durable tumor control while preserving neurological function and quality of life. This study evaluates the efficacy of GKRS as a first-line treatment for LGGs and its impact on quality of life using the Karnofsky Performance Status (KPS) score.

Methods:
A retrospective analysis was performed on 80 patients with biopsy-proven LGGs treated with GKRS between October 2021 and October 2025. Tumor volumes were calculated using GammaPlan® software, and treatment planning was individualized according to tumor size, location, and proximity to critical structures. Clinical and radiological follow-up ranged from 3 to 36 months and included serial MRI evaluations and KPS assessment. Tumor control, progression-free survival (PFS), and overall survival (OS) were analyzed using Kaplan–Meier methods and log-rank testing.

Results:
The mean patient age was 36.5 years, and 63% were male. A total of 93 lesions were treated. Post-GKRS imaging demonstrated tumor volume reduction in 72.5% of lesions, stability in 20%, and progression in 7.5%. Clinical improvement was observed in 78.8% of patients, with an overall tumor control rate of 72.5%. Overall survival was 98.8% at 1 year and 97.5% at 2 years. Patients younger than 50 years showed significantly longer PFS (34.9 vs. 29.7 months, $p = 0.013$) and higher OS rates (93.3% vs. 74.7% at 14–25 months, $p = 0.016$). Tumor control was strongly associated with improved PFS and OS ($p < 0.001$). Multifocal disease independently predicted shorter PFS (HR = 3.32, $p = 0.034$).

Conclusion:
Gamma Knife radiosurgery provides effective tumor control, excellent survival outcomes, and preservation of quality of life in selected patients with low-grade gliomas, supporting its role as a viable first-line treatment option.

PP-084

E-Poster Viewing
SRS – GLIOMAS & OTHER PRIMARY BRAIN TUMORS

THE CLINICAL EFFICACY AND SAFETY OF HYPOFRACTIONATED STEREOTACTIC RADIOTHERAPY COMBINED WITH LOW-DOSE BEVACIZUMAB IN THE TREATMENT OF RECURRENT GLIOBLASTOMA

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Background: Re-irradiation for recurrent glioblastoma can cause radiation-induced brain necrosis, affecting patients' quality of life. Combining low-dose bevacizumab with hypofractionated stereotactic radiotherapy is proposed to reduce brain necrosis. The study aims to evaluate the efficacy and safety of this combination therapy for recurrent glioblastoma.

Methods:A retrospective analysis was performed on hypofractionated stereotactic radiotherapy in 62 glioblastoma patients at our hospital from January 2022 to December 2024. Patients received HSRT at 25 Gy in 5 fractions with low-dose bevacizumab at 5 mg/kg every three weeks. The study assessed ORR, median PFS, median OS, and adverse events.

Results: - Study involved 62 patients, 58% male, 42% female, median age 55.5 years. 55 cases had in situ recurrence, 7 ectopic recurrence. 13 patients had prior electric field therapy, 14 had multiple CyberKnife sessions. Treatment began median 16.4 months post-diagnosis. Median Karnofsky score: 70. Median planned target volume (PTV): 25.85 cc. 61.3% stopped medication, 15 due to side effects, 25 due to various factors. 59 patients received medication for over four courses. Thrombosis-related events affected 10%, hemorrhage-related events 11.2%. Thrombosis events: deep vein thrombosis, cerebral infarction, fatal pulmonary embolism. Hemorrhage events: tumor-related stroke, lower gastrointestinal bleeding, severe gingival bleeding, fatal cerebral hemorrhage. Incidence of grade 1/2 hypertension and proteinuria: 6% each. Median follow-up: 12.1 months, median OS post-salvage treatment: 13.5 months. 1-year PFS: 46.1%, median 11.7 months. 1-year OS: 69.2%, median 19.8 months. Total overall survival for postoperative patients: 36.4 months. Multivariate analysis identified age over 65 as an independent poor prognostic factor, with median overall survival of 10.0 months for elderly patients.

Conclusion: Fractional stereotactic radiotherapy with CyberKnife, combined with low-dose bevacizumab, is a safe treatment for focal relapsed glioblastoma multiforme (GBM). Our results support existing literature on the efficacy of stereotactic radiotherapy for recurrent GBM, emphasizing the need for additional multicenter studies.

PP-085

E-Poster Viewing
SRS – MENINGIOMAS

CLINICAL OUTCOMES OF INTRACRANIAL MENINGIOMAS TREATED WITH STEREOTACTIC RADIOSURGERY: AN EIGHT-YEAR EXPERIENCE FROM A DEDICATED SRS PROGRAM

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Background:
Intracranial meningiomas are among the most common primary central nervous system tumors, and their management continues to evolve with the increasing integration of stereotactic radiosurgery (SRS). Despite widespread use, real-world outcome data from dedicated SRS programs remain essential to refining indications and optimizing therapeutic results. Objectives:
To analyze tumor control, clinical response, overall survival, prognostic associations, and treatment tolerance in patients with intracranial meningiomas treated with SRS at a single institution over an eight-year period.

Methods:
A retrospective review was performed on 103 patients treated between August 2016 and August 2024. Prescribed doses ranged from 14–35 Gy in 1–5 fractions, delivered using a dedicated linear accelerator with image-guided radiotherapy (IGRT). Toxicities were classified according to CTCAE v4.0. Statistical analyses included Pearson's chi-square test and Kaplan–Meier survival estimations.
Results:
Median follow-up was 25 months (range 6–104). Mean age was 57 years (18–88). Fourteen patients (14%) died from disease progression, with a mean time to death of 48 months (12–67). The remaining 89 patients (86%) were alive with radiological tumor control at a mean follow-up of 55 months. Skull base meningiomas accounted for 67% of cases, and 63% of patients had undergone prior surgery. The mean treated tumor volume was 26 cc (0.6–276). Pre-SRS symptoms were present in 50% of patients, with partial or complete clinical improvement documented after treatment. SRS was well tolerated, with low rates of significant acute or late toxicity.

Conclusions:
SRS is a safe, effective, and well-tolerated modality for the management of intracranial meningiomas, providing durable tumor control and meaningful clinical benefit. It represents an optimal treatment option for patients with unresectable lesions or high surgical morbidity risk. These data reinforce the importance of multidisciplinary decision-making and support continued expansion of SRS within modern meningioma care pathways.

PP-086

E-Poster Viewing
SRS – MENINGIOMAS

RAPID RESOLUTION OF PULSATILE TINNITUS AFTER GAMMA KNIFE RADIOSURGERY FOR TENTORIAL MENINGIOMA INVOLVING THE TRANSVERSE SINUS

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Tentorial meningiomas are rare skull base tumors that may cause pulsatile tinnitus when they compress adjacent dural venous sinuses, particularly the transverse sinus. Gamma Knife radiosurgery (GKRS) is an established modality for tumor control, but its role in relieving tinnitus has been infrequently reported. We report a 61-year-old woman with right-sided pulsatile tinnitus caused by a 2-cm tentorial meningioma compressing the right transverse sinus. She underwent GKRS with 13 Gy prescribed to the 50% isodose line, concentrating the 80% isodose volume along the sinus-abutting tumor margin. Her tinnitus resolved completely within one week and remained absent during follow-up. At seven months post-treatment, MRI showed a slight volume decrease (2.81 to 2.66 cm^3), most notable along the sinus interface. The rapid symptom relief despite minimal volumetric change suggests that focused irradiation of sinus-adjacent tumor may alleviate tinnitus by modulating local venous hemodynamics. This case underscores the potential of GKRS to offer early symptomatic improvement in select patients with sinus-involving tentorial meningiomas.

PP-087

E-Poster Viewing
SRS – MENINGIOMAS

CLINICAL OUTCOMES OF REPEAT GAMMA KNIFE RADIOSURGERY FOR PROGRESSIVE WHO GRADE 1 MENINGIOMA

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Background:
Gamma Knife radiosurgery (GKRS) is increasingly utilized for the treatment of WHO grade 1 meningioma, either as an upfront modality or as an adjuvant radiation therapy option. Despite favorable initial tumor control, progression following GKRS remains a clinical challenge, and the role of repeat GKRS as a salvage treatment strategy is not well defined. We evaluated clinical outcomes following repeat GKRS for progressive benign meningioma.

Methods:
We retrospectively reviewed patients with pathologically confirmed WHO grade 1 meningioma who underwent repeat GKRS after radiographic progression following prior radiosurgery at our institution. Patients were treated between July 1992 and December 2021. Twenty-two patients who underwent repeat GKRS were included. The median interval between initial and repeat GKRS, reflecting time to tumor progression, was 72.5 months (range: 10.3–228.5 months). Progression-free survival (PFS) was calculated from the date of repeat GKRS to last follow-up or documented tumor progression. Tumor response was categorized as radiologically stable or reduced versus progressive. PFS was estimated using the Kaplan–Meier method.

Results:
At a median follow-up of 33.3 months (range: 5.4–229.8 months) after repeat GKRS, tumor progression occurred in 7 patients (31.8%), while 15 patients (68.2%) demonstrated stable or reduced tumor size. Kaplan–Meier analysis demonstrated PFS rates of 95.5%, 78.2%, 46.9%, and 31.3% at 1, 3, 5, and 10 years, respectively. Most progression events occurred within the first five years following retreatment, while a subset achieved durable long-term tumor control. Two patients died during follow-up. Among patients with progression after repeat GKRS, two underwent surgical resection, and pathology demonstrated WHO grade 2 meningioma.

Conclusions:
Repeat GKRS provides meaningful tumor control for selected patients with progressive WHO grade 1 meningioma following prior radiosurgery and represents a viable salvage treatment option.

PP-089

E-Poster Viewing
SRS – PITUITARY ADENOMAS

FAILURE PATTERNS OF STEREOTACTIC RADIOSURGERY/STEREOTACTIC RADIOTHERAPY FOR PITUITARY NEURO-ENDOCRINE TUMORS

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Purpose/Objective:
Failure pattern of tumor control after stereotactic radiosurgery/stereotactic radiotherapy (SRS/SRT) for pituitary neuro-endocrine tumors (Pit-NETs) was investigated.

Materials and methods:
Fifty patients, 21 males and 29 females with Pit-NETs were treated by Gamma Knife (GK) or CyberKnife (CK) . The mean of age was 61.1 (25 to 90) years. Diagnoses were non-functioning in 39, ACTH-secreting in four, GH-secreting in five, and PRL-secreting in two. Forty-one tumors are residual or recurrent after surgical resection with or without following medication. The median of tumor volume was 3.4 (0.08 to 21.8) ml. A single session dose of 8 to 20 Gy was delivered in 27 (all GK) and 15 to 45 Gy in 2 to 10 fractions in 23 (GK or CK).

Results:
A median follow-up period of 19 (0.5 to 95) months was obtained after SRS/SRT in 50 cases. All patients were alive at the end of follow-up. The control rate of the treated tumors was 90% (45/50). In analyses with a subgroup of eleven patients with hormone-secreting Pit-NETs, serum ACTH level was decreased in 2 of 4 cases, GH was decreased in 3 of 5, and PRL was decreased in 2 of 2. Failure patterns of enlarged tumor size in five cases were assessed. Solid tumor progression was observed in two cases. Cyst enlargement was developed in two and apoplectic intratumoral hemorrhage was seen in one. Tumor resection was performed in four of five cases. Observation was continued in one cyst enlargement case.

Conclusions:
Tumor control was good after SRS/SRT for both functioning and non-functioning Pit-NETs. Decrease of elevated serum hormones, with improvement of subjective symptoms, was often obtained after SRS/SRT for localized residual or recurrent functioning Pit-NETs, though normalization of hormone levels was still difficult. Cyst enlargement and apoplexy have to be considered as well as solid tumor progression including marginal failure during follow-up observation.

PP-090

E-Poster Viewing
SRS – RARE BRAIN DISORDERS & EMERGING INDICATIONS

RADIOSURGICAL THIRD VENTRICULOSTOMY FOR OBSTRUCTIVE HYDROCEPHALUS: A 16-YEAR INSTITUTIONAL EXPERIENCE

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BACKGROUND: Posterior fossa tumors can be complicated by obstructive hydrocephalus. This study is aimed to meet clinical characteristics, prognostic factors and volume changes observed in patients undergoing radiosurgical third ventriculostomy (RTV).

MATERIAL AND METHODS: A retrospective observational case-series study was performed during the period June 2007 and August 2023. Twenty patients underwent RTV for the treatment of obstructive hydrocephalus, using a LINAC-based stereotactic radiosurgery delivering 100–120 Gy to the premammillary membrane. Evans Index and ventricular volumetry were assessed before treatment, at 24–72 hours, and at 3, 6, and 12 months. Volumetric analysis was performed with BrainLab ELEMENTS and OsiriX. Statistical significance was established at $p < 0.05$.

RESULTS: Twenty patients were treated (median age 40 years). A decrease of the ventricular size detected after radiosurgical third ventriculostomy was related to a satisfactory clinical outcome Evans Index pre-treatment (mean 0.307) improved, with a statistical significant difference at 3 months (p= <.001) , 6 months (p= .002) , and 12 months (p= .001). Ventricular volumetry pre-treatment (mean 66.26 cc) demonstrated significant reductions at 24–72 hours (p= .001) , 3 months (p= .004), and 12 months (p= .020). Mean percentage reduction in ventricular volume was 5.9% at 24–72 hours, 33.4% at 3 months, and 49.6% at 12 months.

CONCLUSION: Radiosurgical third ventriculostomy appears to be a safe and feasible minimally invasive option for selected patients with obstructive hydrocephalus due to posterior fossa tumors. No procedure-related morbidity was observed. Further prospective studies are needed to refine patient selection and define optimal technical parameters.

PP-091

E-Poster Viewing
SRS – VASCULAR DISORDERS

FACTORS ASSOCIATED WITH ACUTE SEIZURES FOLLOWING GAMMA KNIFE (GK) RADIOSURGERY FOR ARTERIOVENOUS MALFORMATIONS (AVMS) IN A SINGLE AUSTRALIAN CENTRE

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Purpose: To identify risk factors for acute seizures following Gamma Knife radiosurgery for cerebral AVMs.

Methodology: A retrospective audit of patients treated with GK for AVMs at our centre between October 2015 and November 2019 was performed. Follow-up data was collected for a minimum of 3 years after GK. Analysis was performed per GK treatment course to include multistage and multi-AVM patients.

Results: 108 GK treatments were delivered to 93 patients aged 14-72 years. 11 patients received multi-stage GK. Seizures occurred after GK at any time in 34/108 (31%) treatments, and in 15/108 (14%) within 30 days of GK (acute). Acute seizures following GK were associated with prior seizure history (73% vs 34% no prior seizures, p=0.0104) and use of antiepileptic drugs (AED) before GK (p=0.0085). AED non-compliance was more common in patients who experienced acute seizures (20% vs 9%). Patients who had experienced prior haemorrhage from their AVM were less likely to have acute seizures following GK (20% vs 49%, p=0.0489). Acute seizures were more common after multistage GK treatments than single stage (5/15, 33% vs 18/93, 19%), though this did not reach statistical significance (p=0.3047). Age, gender, history of prior neurosurgery, irradiated nidus volume, covering isodose prescription, and omission of peri-procedural dexamethasone were not associated with acute seizures. Temporal lobe AVM location versus non-temporal lobe did not predict for acute seizures post GK; parietal lobe location represented 5 of 15 of the acute seizures.

Conclusion: The incidence of acute seizures after GK for AVMs is greater in patients with a history of seizures and AED noncompliance, but not associated with age, gender, GK dose, nidus volume or periprocedural dexamethasone omission.

PP-092

E-Poster Viewing
SRS – VASCULAR DISORDERS

SINGLE VS MULTIFRACTION STEREOTACTIC RADIOSURGERY FOR ARTERIOVENOUS MALFORMATION

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Background : Stereotactic radiosurgery (SRS) is well established treatment modality for Arteriovenous malformations (AVM). Radiobiologically, Arteriovenous malformation behaves like an late-reacting tissue which implicates that higher dose per fraction will achieve better obliteration of nidus.In our study we have compared obliteration rates of single (SRS) and multifraction stereotactic radiosurgery (fSRS) for intracranial AVM.

Materials and methods : We retrospectively compared 23 patients who received single fraction SRS and 22 patients with multifraction SRS (No. of fractions - 3) for intracranial arteriovenous malformation from 2020 to 2025. Median dose prescribed was 21Gy (21-24 Gy) and 18Gy (14-18 Gy) in fSRS and SRS group respectively. Median volume of nidus was 5.35 cc (1.1 – 8 cc) and 20 cc (16-44 cc) in SRS and fSRS group respectively. Obliteration rates were calculated for SRS and fSRS group and compared. We analyzed volume of Brain receiving 12 Gy (V_{12Gy}) in SRS group and dose received by 20 CC of Brain (D_{20cc})in fSRS group and its correlation with volume of nidus.

Results The median follow up was 36 months (6-48 months). The obliteration rates in single fraction SRS group at 12, 36 and 48 months were 62%, 85.2% and 100 % respectively. The obliteration rates in fSRS group at 12, 36 and 48 months were 40.7%, 65.3% and 80.1% respectively. The obliteration rates at 12, 36 and 48 months were significantly better in SRS group compared to fSRS group (p-value - 0.008, <0.001 and 0.01 respectively). The V_{12Gy} and D_{20cc} were significantly higher with high volume of nidus in SRS group (p-value – 0.02) and fSRS group (p-value – 0.001) respectively.

Conclusion: We conclude that single fraction has better obliteration rate compared to multifraction SRS. For large sized AVM, volume staged SRS might be better to achieve complete obliteration of nidus with minimal radiation induced Brain necrosis.

PP-093

E-Poster Viewing
SRS – VASCULAR DISORDERS

STEREOTACTIC RADIOSURGERY FOR VEIN OF GALEN ARTERIOVENOUS MALFORMATION: OUTCOMES FROM A SINGLE-CENTER STUDYSTEREOTACTIC RADIOSURGERY FOR VEIN OF GALEN ARTERIOVENOUS MALFORMATION: OUTCOMES FROM A SINGLE-CENTER STUDY

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Introduction: Vein of Galen arteriovenous malformation (VGAM) is a rare congenital vascular anomaly. This study evaluates the efficacy and safety of stereotactic radiosurgery (SRS) for VGAM.
Methods: A retrospective analysis was performed on 69 patients with VGAM treated with SRS. The median target volume was 2.03 cm^3. Radiosurgery modalities included Gamma Knife (8.7%), CyberKnife (79.7%), and TrueBeam STx (11.6%). The median prescription dose was 20.19 Gy. Prior endovascular embolization was performed in 76.8% of cases.
Results: The median follow-up was 36 months. Complete obliteration was achieved in 50% of patients, while 39.1% showed a reduction in malformation size. The median obliteration-free survival was 47 months. The obliteration-free survival probability at 87.4 months was 0.054. Post-SRS hemorrhage occurred in 1.6% of patients. No radiation-induced edema, necrosis, or adverse reactions were reported. No significant correlation was found between obliteration and gender, target volume, prior hemorrhage, dosimetric parameters, or the SRS device used.
Conclusion: SRS is a safe and effective treatment for VGAM, demonstrating a high obliteration rate with minimal complications. Prior embolization does not negatively impact outcomes. SRS can be considered as a definitive or adjuvant treatment, particularly in pediatric and young adult populations.

PP-094

E-Poster Viewing
SRS – VASCULAR DISORDERS

REPEAT STEREOTACTIC RADIOSURGERY FOR DEEP-SEATED CEREBRAL ARTERIOVENOUS MALFORMATIONS IN THE BASAL GANGLIA, THALAMUS, CORPUS CALLOSUM, AND BRAINSTEM.

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Objective: The management of deep-seated cerebral arteriovenous malformations (AVMs) poses significant challenges due to their high hemorrhagic risks and complex anatomical locations. This study aimed to evaluate both radiological and clinical outcomes in patients who underwent repeat stereotactic radiosurgery (SRS) for residual deep-seated cerebral AVMs following initial SRS treatment.

Methods: We performed a retrospective analysis of patients with deep-seated AVMs treated at our institution from 2009 to 2024

Results: The study included 31 patients (20 males [64.5%]) who underwent repeat SRS for residual deep-seated AVMs. The median age at the time of repeat SRS was 22.0 years (IQR: 20.5). The AVMs were primarily located in the thalamus and corpus callosum (29.0% each), brainstem (22.6%), and basal ganglia (19.4%). The median nidus volume at the second SRS was 1.3 cm^3 (IQR: 4.8), with a median prescription dose of 16.0 Gy (IQR:5.0) at a 50% isodose line. The median follow-up duration was 83.0 months (IQR: 61.5), during which AVMs obliteration was achieved in 7 patients (22.6%). Nineteen patients (61.3%) were deceased by the last follow-up. The median interval between the initial and repeat SRS was 48.3 months (IQR: 21.0). Hemorrhagic events occurred in 4 patients (12.9%) between treatments and in 5 patients (16.1%) after the second treatment, with one resulting in fatality. Lower initial radiation dose correlated significantly with an increased risk of hemorrhage. ($p<0.05$) Transient radiation-induced changes (RIC) were observed in 54.8% of patients after the second SRS, and 16.1% experienced symptom.

Conclusion: Repeat SRS is a reasonable treatment option for residual deep-seated cerebral AVMs following initial SRS treatment. To manage potential complications, careful monitoring and close oversight is required throughout the course of treatment.

PP-095

E-Poster Viewing
SRS – VASCULAR DISORDERS

GAMMA KNIFE RADIOSURGERY FOR A RADIATION-INDUCED ARTERIOVENOUS MALFORMATION DEVELOPING AFTER CHILDHOOD WHOLE-BRAIN RADIATION THERAPY (WBRT): A CASE REPORT

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Background
Radiation-induced arteriovenous malformations (AVMs) are rare late complications of childhood whole-brain radiation therapy (WBRT). Their optimal management is unclear, particularly in the previously irradiated brain, where surgical and endovascular interventions carry substantial risk. We describe successful GKRS treatment for a late-onset AVM decades after WBRT.

Case Description
The patient, treated for ALL at age 2 (with no cerebrovascular abnormalities at that time), was lost to follow-up until age 34, when MRI incidentally revealed a left parietal AVM and a right parietal cavernous malformation (CM). These bilateral yet distinct lesions suggested a possible radiation-associated vascular predisposition, although histological confirmation was unavailable. The CM remained stable and was observed. Given the patient's young age and concern for lifelong hemorrhage risk, active treatment of the AVM was recommended. The AVM measured 23.5 mm and was Spetzler–Martin Grade I. Given the anticipated tissue fragility in the previously irradiated brain, microsurgical resection was considered high-risk. Endovascular therapy was not considered a definitive treatment option. Consequently, GKRS was selected as the safest option. GKRS was delivered to a 1.86-cc nidus with 20 Gy at the 52% isodose line. The patient experienced transient, asymptomatic radiation-induced imaging changes (RICS).

Results
Gradual nidus involution was observed, and complete radiographic obliteration was achieved at 26 months, confirmed by the absence of abnormal vascular signals on TOF-MRA. He remained neurologically intact, with no delayed toxicity beyond the transient RICS episode.

Conclusion
This case highlights therapeutic considerations for radiation-induced AVMs, whose natural history remains poorly defined decades after WBRT. In the previously irradiated brain, where tissue fragility increases procedural risk, GKRS offers a favorable balance of safety and efficacy. The coexistence of an AVM and a contralateral CM illustrates the heterogeneous spectrum of late radiation-associated vascular changes and underscores the importance of individualized management and long-term surveillance.

PP-096

E-Poster Viewing
SRS – VASCULAR DISORDERS

GAMMA KNIFE RADIOSURGERY FOR PURE ARTERIAL MALFORMATION ASSOCIATED WITH PSEUDOANEURYSM: CASE REPORT AND LITERATURE IMPLICATIONS

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Background Pure arterial malformations (PAMs) are rare cerebrovascular anomalies characterized by tightly coiled, dilated, and tortuous arteries without venous components or arteriovenous shunting. PAMs are often incidentally discovered and traditionally considered benign; however, some demonstrate progression or pseudoaneurysmal changes that raise concerns for future rupture or clinical sequelae. Given the deep or surgically challenging locations of many PAMs, optimal management strategies remain undefined. Objective This study aimed to describe the clinical course and outcomes of Gamma Knife radiosurgery (GKRS) as a treatment alternative for a PAM with pseudoaneurysm in a surgically inaccessible region, and to discuss its potential role in managing similar vascular anomalies. Methods We present the case of a 58-year-old man with a PAM originating from the left anterior choroidal artery, incidentally identified on magnetic resonance imaging (MRI). Digital subtraction angiography (DSA) confirmed the diagnosis and revealed pseudoaneurysmal dilation, rendering surgical or endovascular intervention high-risk. The patient underwent GKRS with a marginal dose of 18 Gy prescribed to the 50% isodose line. Radiosurgical planning was based on high-resolution imaging to precisely target the lesion while sparing adjacent eloquent structures. Results Follow-up MRI at 6 months demonstrated a marked reduction in lesion size and loss of the characteristic tortuous arterial configuration. At 3 years post-treatment, cerebral angiography confirmed complete obliteration of the malformation. The patient remained neurologically intact with no radiosurgery-related complications throughout the follow-up period. Conclusion Gamma Knife radiosurgery may represent a safe and effective non-invasive treatment option for select PAMs, particularly those located in surgically challenging regions or associated with pseudoaneurysmal changes. While evidence remains limited to isolated case reports, these findings support further investigation into radiosurgical indications, long-term outcomes, and optimal dose strategies for PAM management. Future studies with larger cohorts are warranted to define treatment guidelines and refine patient selection criteria.

PP-097

E-Poster Viewing
SRS – VASCULAR DISORDERS

HYPOFRACTIONATED GAMMA KNIFE RADIOSURGERY FOR LARGE CEREBRAL ARTERIOVENOUS MALFORMATIONS: A RETROSPECTIVE COHORT STUDY OF 54 PATIENTS

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Background and Objectives:
Treatment of large cerebral arteriovenous malformations (AVMs) remain challenging. Single-session stereotactic radiosurgery offers excellent obliteration rates for small, compact AVMs but adverse radiation effects (AREs) limit its use in large AVMs. This study aims to evaluate the efficacy and safety of hypofractionated Gamma Knife radiosurgery (HF-GKRS) for large cerebral AVM.
Methods:
54 patients who underwent HF-GKRS for large AVMs and had a follow-up of 36 months were retrospectively analyzed. Nidus obliteration was the primary outcome, with bleeding and ARE as secondary outcomes. Clinical-radiological variables calculated. Factors associated with complete obliteration (CO) were examined using univariate and multivariate logistic regression. Results:
The mean patient age was 34.7 years (median 33); the mean AVM volume was 17.4 cc (median: 15.05 cc); and the mean follow-up period was 45.7 months (median: 40.5 months). CO was observed in 20 patients (37%) at the end of the first 3 years. In the remaining patients, 6 achieved CO with a single HF-GKRS session after 36 months (range, 40-60 months). A second GKRS treatment was performed in 21 patients, and 9 (42.86%) achieved CO. CO was observed in 35 patients (64.8%) in a mean of 39.1 months (median: 36 months). 5x6 Gy provided better results than other treatment regimens. Prior
embolization was found to have a negative effect on obliteration (p=0.030). After treatment, perinidal edema was observed in 2 patients, radionecrosis in 2 patients, and late rupture-related death was observed in 1 patient.
Conclusion:
HF-GKRS is associated with a high rate of CO and a low rate of radiation-induced changes in large AVMs. Prospective, multicenter studies are required for dose-fraction optimization.

PP-098

E-Poster Viewing
SRS – VASCULAR DISORDERS

RADIOSURGERY FOR SECONDARY EPILEPSY ASSOCIATED WITH DOUBLE BRAIN ARTERIOVENOUS MALFORMATION

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Background: Multiple brain arteriovenous malformations (BAVMs) are uncommon, representing 0.3–3.2% of cases, and seizures are their second most frequent clinical manifestation. Treatment options include microsurgery, radiosurgery (RS), and endovascular embolization, used alone or in combination. RS is a minimally invasive modality suitable for small to medium BAVMs, particularly those in deep or eloquent regions.

Case Presentation: We report the case of a 54-year-old man with one month of right foot hypoesthesia and left-sided Jacksonian seizures. Angiography identified two separate BAVMs: one in the left parahippocampal gyrus, supplied by branches of the posterior cerebral artery and draining into the superior petrosal sinus, and another in the postcentral gyrus, fed by the paracentral artery and draining into the superior longitudinal sinus. Both were treated in a single session using LINAC-based RS without complications. The parietal BAVM received 22 Gy via 9 conformal static fields, and the parahippocampal BAVM received 20 Gy via 8 conformal static fields. Within three months, seizure frequency decreased by over 50%. At six months, antiseizure medications (ASM) dosages were reduced to one-third of the initial regimen. Over two years, the patient maintained satisfactory seizure control despite incomplete angiographic obliteration and no new neurological deficits. At five years, he reported only five motor-onset seizures involving the right lower limb (Engel IB) and remained on a single ASM, representing a two-thirds reduction from baseline, with no radiation-induced adverse effects.

Conclusion: This case highlights a rare case of a double BAVMS with improved neurological function and reduced ASM dependence following RS, supporting its role as an effective, minimally invasive treatment for multiple BAVMs associated with secondary epilepsy.

PP-099

E-Poster Viewing
SRS – VESTIBULAR SCHWANNOMAS

AUDIO-VESTIBULAR PROFILE AND REHABILITATION EFFICACY IN VESTIBULAR SCHWANNOMA PATIENTS UNDERGOING LINAC-BASED RADIOSURGERY

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Objective: Vestibular Schwannoma (VS) management increasingly focuses on functional preservation. While hearing outcomes after Stereotactic Radiosurgery (SRS) are well-documented, the correlation between objective vestibular deficits, subjective dizziness, and the efficacy of targeted rehabilitation remains under-investigated. We aimed to evaluate audio-vestibular function in VS patients before and after LINAC-based SRS and assess the clinical benefit of dynamic posturography-based vestibular rehabilitation.

Materials and Methods: This prospective study enrolled patients with unilateral VS treated with LINAC-SRS. The comprehensive assessment battery included pure-tone and impedance audiometry, Otoacoustic Emissions (OAE), Auditory Brainstem Response (ABR), Videonystagmography (VNG) with caloric and oculomotor testing, and static/dynamic posturography. Subjective symptom severity was quantified using the Dizziness Handicap Inventory (DHI) and the Vertigo Symptom Scale-Short Form (VSS-SF). A subset of patients exhibiting significant uncompensated vestibular deficits underwent a customized rehabilitation protocol using a dynamic posturography system.

Results: Preliminary analysis indicates a high prevalence of objective vestibular dysfunction in the study cohort, frequently exceeding the severity of patient-reported symptoms. This discrepancy suggests active central compensation or under-reporting of deficits in standardized questionnaires. Post-SRS assessments revealed complex fluctuations in vestibular function, with VNG and posturography identifying deficits not apparent in basic clinical examination. Notably, patients who completed the vestibular rehabilitation program demonstrated a reduction in DHI and VSS-SF scores and improved stability limits on posturography compared to baseline. However, the correlation between objective gain recovery and subjective relief requires further longitudinal evaluation.

Conclusions: Patients undergoing LINAC-SRS for VS frequently present with significant, often subclinical, vestibular impairment. Instrumental diagnostics are superior to subjective scales in detecting these deficits. Early implementation of vestibular rehabilitation using dynamic posturography appears effective in mitigating subjective symptoms and improving quality of life. Long-term follow-up is essential to determine the durability of rehabilitation effects and the final impact of SRS on vestibular physiology.

PP-100

E-Poster Viewing
SRS – VESTIBULAR SCHWANNOMAS

TWO-WEEK INTERVAL HYPOFRACTIONATED GAMMA KNIFE RADIOSURGERY FOR VESTIBULAR SCHWANNOMA: CLINICAL AND VOLUMETRIC OUTCOMES

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Objective:
To evaluate the safety, efficacy, and volumetric kinetics of two-week interval hypofractionated Gamma Knife radiosurgery (hfGKRS) for vestibular schwannoma (VS) compared with single-fraction GKRS (sfGKRS).

Methods:
Between 2016 and 2022, 46 VS patients underwent hfGKRS (2–5 fractions, 2-week intervals). Propensity score matching (1:1) was performed with 41 sfGKRS patients, balanced for age, sex, tumor volume, Koos grade, baseline hearing, and follow-up duration. Tumor control rate (TCR), volume change rate (VCR), pseudoprogression, and hearing preservation were analyzed.

Results:
Overall TCR was 98.4%, and the median VCR was −0.21% per month. In matched cohorts, long-term volumetric control was equivalent between hfGKRS and sfGKRS (100% vs. 97.6%, $p > 0.99$). However, pseudoprogression occurred more frequently after hfGKRS (41.5% vs. 19.5%, $p = 0.03$). Functional hearing preservation rates were comparable (60.0% vs. 40.0%, $p = 0.17$). Early transient enlargement typically occurred within 12 months after hfGKRS, followed by gradual regression up to 36 months.

Conclusion:
Two-week interval hfGKRS provides tumor control equivalent to sfGKRS with similar hearing preservation and acceptable toxicity for vestibular schwannoma. The biweekly schedule may enhance vascular and immunologic modulation, leading to characteristic early volumetric dynamics while maintaining clinical safety. This regimen represents a practical and biologically rational option for large VS or lesions close to the cochlea or brainstem.

PP-101

E-Poster Viewing
SRS – VESTIBULAR SCHWANNOMAS

LONG-TERM OUTCOMES AND HEARING PRESERVATION AFTER RADIOTHERAPY (FSRT/SRS) FOR VESTIBULAR SCHWANNOMAS: A RETROSPECTIVE REVIEW

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OBJECTIVE Non-invasive treatment modalities, stereotactic radiosurgery (SRS) and fractionated stereotactic radiotherapy (FSRT) have emerged as effective alternatives to microsurgical resection in vestibular schwannomas (VS) offering favourable tumour control and preservation of neurological function.This is a retrospective review to assess the clinical outcomes , hearing rates and toxicity profiles post treatment with FSRT and SRS

METHIDS AND MATERIALS 50 patinets were analysed retrospectively from feb 2015 - April 2025.Radiologocally diagnosed VS were taken up for either single fraction 12Gy SRS or FSRT to a dose of 25Gy in 5 fractions. All patinets had KOOS staging , baseline Audiometry and hearing status was divided into servicable or non servicable based on Gardner Robertson grading. Hearing preservation was defined as maintaining Gardner-Robertson Class I–II at last follow-up. Chi square tests was used to compare hearing rates and log rank tests were used to assess local control. Toxicity assessment was done using CTCAE grading.

RESULTS The median follow up 48 months (6-72m) . The median PTV volume for srs and Fsrt was 1.40 and 8.46 respectively.No significant difference between SRS and FSRT were found with respect to hearing preservation(p=0.90). The local control at a 2, 3 and 4 years were 100,%92,% and 90 % respectively, in both the groups(0.99). None required any form of salvage treatments or re-radiationTreatment-related toxicity was mild or moderate, in general not exceeding CTCAE Events grade 2.

CONCLUSION “Frameless FSRT and SRS treatment of VS results in good rate of tumor control ,hearing preservation rate and a favourable toxicity profile rates as to what is reported in the literature. Patients choose this modality because of its non-invasive nature and are generally very satisfied with their long term outcome.

PP-102

E-Poster Viewing
SRS / SBRT – OCULAR DISORDERS

STEREOTACTIC ABLATIVE RE-IRRADIATION FOR RECURRENT CHOROIDAL MELANOMAS AFTER PLAQUE BRACHYTHERAPY

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Background: Stereotactic linear accelerator-based radiotherapy (SRT) is used for choroidal melanomas, with high local control rates and similar toxicities compared to brachytherapy and enucleation. In the setting of progressive recurrent disease, options for salvage include enucleation with loss of the eye. There is limited evidence in the setting of previously irradiated choroidal melanomas with local recurrence in using stereotactic re-irradiation to preserve the eye. We assessed our series of re-irradiation of choroidal melanomas using SRT. Methods: We performed a retrospective case review of patients treated with SRT for locally recurrent choroidal melanomas from 2010 to 2025. We assessed local and distant failure, and toxicity outcomes. Results: Four patients met selection criteria. Previous plaque brachytherapy treatment involved Ruthenium-106 in three patients and Iodine-125 in one patient. All patients had been treated with 85 Gy to the apex of the melanoma. Time from plaque brachytherapy to local recurrence ranged from 15 months to nine years. Tumour thickness at recurrence ranged from 3.2 to 4.1mm, and diameter was measured between 6 and 15mm. All patients were treated with eye fix immobilization using 50 Gy in five fractions, delivered every other day. Last follow-up after completion of reirradiation ranged from 1.5 to two years. All patients had regression of their tumour and preservation of their eye, and none had evidence of distant progression. One patient developed retinopathy and was managed conservatively. Conclusion: Reirradiation of recurrent choroidal melanomas using SRT appears feasible, resulting in tumour regression, and appears to be safe, allowing for preservation of the eye with no added toxicity effects at short term follow-up of 1.5-2 years.

PP-103

E-Poster Viewing
SRS / SBRT – OCULAR DISORDERS

SINGLE FRACTION STEREOTACTIC RADIOSURGERY AS A TREATMENT OF CHOICE FOR DIFFUSE CHOROIDAL HEMANGIOMA IN PATIENTS WITH STURGE-WEBER SYNDROME

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Diffuse choroidal hemangioma (DCH) complicated with retinal detachment is a challenging condition. In many published single cases or limited case series, various treatment options such as laser, brachytherapy, photodynamic therapy, external beam radiotherapy, proton beam therapy, intraocular medication, oral Sirolimus, or Propranolol, had been attempted and did not show satisfactory results. **Purpose**: to present our experience in single fraction stereotactic radiosurgery (SRS) of DCH in patients with Sturge-Weber syndrome. **Methods**: Twelve patients with DCH aged from 7 to 32 years (mean 14), 11 of them at the age under 18 years, were referred to our clinic. All patients had facial port-wine stains, 2 of them had leptomeningeal angiomas, 2 bilateral DCH. All patients were presented with DCH of 6.8 mm in maximum thickness (range, 3.9-7.3 mm), retinal detachment (mean thickness 3.6 mm, maximum 6.6 mm), and poor vision. One 4-year girl had the only seeing eye after unsuccessful treatment of the fellow eye. Six patients were treated with Gamma-Knife (GK-SRS), 6 with CyberKnife stereotactic radiosurgery (CK-SRS). Dosimetric plans included macula-sparing target volumes of 18 Gy@50% on marginal isodose. **Results**: In all cases, tumor thickness decreased to mean thickness of 2.5 mm (range, 1.0- 3.3 mm), subretinal fluid gradually decreased and ultimately resolved with retina flattening, vision improved to mean 0.3. Irradiation “tracks” of very mild chorio-retinal atrophy according to the planning were seen on the eye fundus examination without radiation damage to macula. No retinal detachment recurrences, no complications were revealed within the mean follow-up of 28 months (range, 8-83) after RS. Results after GK-SRS and CK-SRS are similar, some differences will be discussed. **Conclusion**: Our experience in treating patients DCH in Sturge-Weber syndrome using different approaches showed SRS to be the treatment of choice. SRS allowed to irradiate intraocular vascular tumors precisely and save the eye with vision improvement.

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E-Poster Viewing
SRS / SBRT – SPINE (PRIMARY & SECONDARY TUMORS)

A RANDOMIZED PHASE III STUDY COMPARING STEREOTACTIC BODY RADIOTHERAPY (SBRT) VERSUS CONVENTIONAL PALLIATIVE RADIOTHERAPY (CRT) FOR PARTICIPANTS WITH PAINFUL NON-SPINE BONE METASTASES (NCT06391242)

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Background: Stereotactic body radiotherapy (SBRT) is efficacious in the treatment of painful spinal metastases [1]. Data are required regarding the efficacy feasibility, toxicity and clinical outcomes associated with SBRT in patients with painful non-spine bone metastases prior to widespread adoption of this technique. **Methods**: This is a Canadian Cancer Trials Group led multi-centre, phase III randomized controlled trial comparing SBRT to conventional palliative external beam radiotherapy (CRT) in patients with solid tumours and a dominant painful non-spine bone metastasis (worst pain score ≥2). *Treatment arms:* EBRT 20Gy/5fr (control) versus SBRT 35 Gy/5fr or 30Gy/5fr (experimental). *Primary objective*: To compare 3-month complete pain response (CPR) rate and analgesic intake assessed using the International Consensus on Palliative Radiotherapy Endpoints [2]. Secondary objectives evaluate pain response pattern at 1, 3 and 6 months and assess re-irradiation rates, fracture incidence within RT target site, incidence of Grade ≥ 2 adverse events, image-based local control, and patient reported outcomes (EORTC QLQ-C30 and QLQ-BM22). *Statistical design:* The target accrual is 230 patients, randomized 1:1. The trial is powered at 80% with a two-sided alpha of 0.05 to detect an improvement in the CPR rate from 17% (CRT) to 34% (SBRT), accounting for a 15% missing data rate. *Conduct to Date***:** Study was activated on June 26, 2024 **Supported by CCS grant # 707213** [1] Sahgal, Arjun, et al. "Stereotactic body radiotherapy versus conventional external beam radiotherapy in patients with painful spinal metastases: an open-label, multicentre, randomised, controlled, phase 2/3 trial." *The Lancet Oncology* 22.7 (2021): 1023-1033. [2] Chow E, Hoskin P, Mitera G et al. Update of the international consensus on palliative

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