Abstract 2187; Table 1.

		Lateral (X mm)	Longitudinal (Y mm)	Vertical(Z mm)	Pitch (X°)	Yaw(Y°)	Roll(Z°)
Leksell	Average Stand.Dev	0.06 0.04	0.04 0.03	0.03 0.03	0.35 0.32	0.10 0.09	0.20 0.15
Fraxion	Average Stand.Dev	0.08 0.06	0.09 0.09	0.12 0.09	0.43 0.33	0.40 0.35	0.41 0.32

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Purpose/Objective(s): Addition of sequential multi-agent chemotherapy consisting of procarbazine, lomustine, and vincristine (PCV) before or after radiation therapy (RT) has been shown to improve overall survival (OS) in pure anaplastic oligodendroglioma (AO) and mixed anaplastic oligoastrocytoma (AOA). This large observational study aims to investigate the utilization and impact of concurrent single-agent chemotherapy on OS for AO and AOA treated with RT.

Materials/Methods: AO and AOA patients who underwent RT alone or with concurrent single-agent chemotherapy (ChemoRT) between 2004 and 2012 were identified from the National Cancer Data Base (NCDB). Concurrent chemotherapy was specified to be within 14 days from the start of RT. Prognostic factors affecting OS were evaluated using Kaplan Meier product-limit method and Cox proportional hazards. Propensity score matching (PSM) was used to adjust for differences in age, comorbidities, histology, diagnosis year, gender, race, insurance and education between RT alone and ChemoRT patients.

Results: A total of 1,511 patients with AO (n = 802, 53%) and AOA (n = 709, 47%) were identified. Three hundred and six patients (20%) received RT alone while 1,205 patients (80%) received ChemoRT. ChemoRT utilization increased over time (60% in 2004 to 90% in 2012, $P<0.001$). The following co-variates were associated with ChemoRT use: younger age ($P = 0.002$), private insurance ($P = 0.001$), AO histology ($P = 0.007$), white race ($P = 0.003$) and later diagnosis year ($P<0.001$). Median follow up time was 40 months. Patients who underwent ChemoRT had a higher 5-year OS compared to those who did not (63% vs 53%, $P<0.001$). On multivariate analysis, ChemoRT was independently associated with improved OS (Hazard Ratio: 0.74, 95% Confidence Interval: 0.60 − 0.91, $P = 0.004$) along with younger age, lower Charlson comorbidity score, AO histology and later diagnosis year. On subset analysis, ChemoRT was associated with improved 5-year OS compared to RT alone for both AO histology (66% vs 57%, $P = 0.042$), and AOA histology (60% vs 49%, $P = 0.002$). When treatment groups were matched 1:1 using PSM (283 pairs), ChemoRT continued to show improved 5-year OS as compared to RT alone (64% vs 55%, $P = 0.046$).

Conclusion: RT combined with single agent concurrent chemotherapy (ChemoRT) is associated with improved OS for AO/AOA as compared to RT alone in routine clinical practice. Prospective comparison of this ChemoRT approach to sequential PCV and RT is warranted.

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Accuracy Treatments With Frameless Stereotactic Radiosurgery

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Purpose/Objective(s): Radiosurgery treatments using invasive cranial frame-based immobilization systems have amply demonstrated their accuracy. Modern treatment techniques tend to replace fixed immobilization systems (uncomfortable for patients) with new Frameless immobilization systems. We aimed to demonstrate the accuracy of the treatment using a Frameless system (Fraxión model) and a robotic table with 6 degrees of freedom (Hexapod table model).

Materials/Methods: We compared 14 patients who were treated with single fraction radiosurgery for brain metastases. Seven of them using frame-based immobilization system (Leksell model) and 7 using a thermoplastic mask, vacuum mattress, cervical and oral fixation (Fraxion model). In each of the 14 patients a robotic table with 6 degrees of freedom (Hexapod model) was used. In all cases a pre and post cone-beam CT were performed, in order to compare both translational and rotational intrafraction motion. Translational axis X (lateral), Y (longitudinal) and Z (vertical); and rotational: X angle or Pitch (right and left rotation), Y angle or Yaw (anteroposterior rotation axis) and Z angle or Roll (superior-inferior rotation axis). The treatment technique we used was Volumetric Modulated Arc-therapy (VMAT) with a single isocenter and a minimum of 5 non-coplanar arcs, using the Monaco 5 planner (Monte Carlo algorithm). Six MV photons supplied by a LINAC with multileaf collimator of 0.4 cm sheets at isocenter were used.

Results: The analysis of the images obtained from 28 cone-beams CT, 14 of each immobilization system, offers intrafraction differences(mean and standard deviation) of less than 1mm in translational motion (X, Y, Z) and less than 0.5o in rotational motion. It is slightly smaller with frame-based immobilizer (Leksell) as shown in Table 1 below.

Conclusion: The robotic table with 6 degrees of freedom (Hexapod) allows for repositioning with pinpoint accuracy. The Frameless immobilization system we used (Fraxion model) confers superponible intrafraction stability as the classic Frame-based systems, so that it is not necessary to extend the PTV margin. The Frameless immobilization system (Fraxion model) is much more comfortable for the patient and easier to integrate into the radiation therapy department workflow, involving less service staff than the classics systems.

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Deferred Radiation Therapy After Debulking of Nonfunctioning Pituitary Macroadenomas: An Appropriate Option

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Purpose/Objective(s): To describe long term outcomes for a cohort of patients with non-functioning pituitary macroadenomas (NFPM) managed with debulking surgery with radiation therapy deferred until progression.

Materials/Methods: Two hundred sixty-seven patients underwent surgical resection for pituitary tumors at a single institution between 1997 and 2005. Of these, 12 patients received adjuvant radiation and were therefore excluded. 126 patients met the inclusion criteria of having

non-functioning pituitary macroadenomas (NFPA), with at least two years of follow up.

Results: Pre-operatively, 58% had objectively decreased visual function, 66% had endocrine abnormalities, and 46% had headaches. Seventy-five percent of tumors compressed the optic chiasm, 40% invaded the cavernous sinus, and 87% had supra-sellar extension. The post-surgical median follow up period was 112 months. During the follow up period, 52% of patients had tumors with evidence of radiographic progression, and 39% of patients required additional treatment (15% radiation therapy, 16% additional surgery, 8% both). There was a significant difference in the median time to additional treatment based on preoperative size stratification. For lesions 1-1.99 cm in size, the median time to treatment was not reached, 2-3.99 cm was 119 months, for lesions >4cm it was 45 months (Table 1, $P<0.05$).

Conclusion: Patients presenting with residual post-operative NFPM's can undergo observation with delayed radiation, as the majority of patients did not require further intervention for ten or more years. Patient with larger tumors (>4 cm) are still be appropriate candidates for deferring radiation therapy, but have a higher risk of requiring treatment during the first decade after diagnosis.

Abstract 2188; Table 1. Progression Based on Pre-operative Size

Size in cm	Overall PFS 5 yr	Overall PFS 10yr	Treatment PFS 5 yr	Treatment PFS 10yr	Median Time to Treatment
1-1.99 (n = 22)	84.2	46.4	95	82.9	Undefined
2-2.99 (n = 43)	58.5	24.2	66.8	42.3	115 months
3-3.99 (n = 25)	49.1	23.2	76	58	
>4 (n = 9)	22.2	0	44.4	16.7	45 months

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Analysis of Prognostic Factors for Local Recurrence in Atypical Meningiomas

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Purpose/Objective(s): The optimal adjuvant management for atypical meningiomas remains controversial. This is particularly true after a gross total resection (GTR). The aim of this study was to review long-term outcomes in such patients and to identify factors associated with benefit from adjuvant therapy.

Materials/Methods: Between 1992 and 2013, we retrospectively identified 72 patients with atypical meningioma treated at our institution. Patients with multiple tumors, neurofibromatosis type 2, or inadequate follow-up imaging were not eligible. Pathology was reviewed in each case to confirm grading. We performed pre- and post-operative serial measurements of tumor volume from magnetic resonance imaging. Age, tumor location, bone involvement, extent of resection, tumor growth rate, use of post-operative radiation therapy (PORT), and residual tumor volume at time of radiation therapy (RT) were assessed by uni- and multivariate analysis to determine their influence on local control.

Results: Forty-two patients (58%) underwent GTR and 30 (42%) underwent a subtotal resection (STR). PORT was delivered to 12 patients (28.5%) with GTR and only 6 (20%) with subtotal resection (STR). Control rates at 5 years for GTR patients with or without PORT were 100% versus 46% (median time for failure = 51 months), respectively ($P<0.01$). Similarly, for STR patients +/- PORT were 50% versus 37.5%, respectively ($P = 0.53$). On multivariate analysis, no-PORT and STR were the only independent significant prognostic factors for local recurrence with HR of 6.5 (95% CI 2.75-15.42) and 8.81 (95% CI 2.34-33.24), respectively. Based on Youden-Index-J, a cut-off residual volume of less than 8.76 cc was associated with lower failure rate (7% vs 77%, $P<0.001$). In patients not receiving RT, the median relative and absolute growth rates, and tumor doubling time were 115.75%/year, 4.27 cc/year, and 0.78 year, respectively. These indices improved after the addition of RT (74.5%/year, 2.48 cc/year, and 1.73 year, respectively).

Conclusion: In patients with atypical meningioma undergoing GTR, the use of PORT is associated with significant improvement in local control. The small number of STR patients receiving PORT precludes a meaningful analysis. Patients with a residual tumor larger than 8.76 cc have an increased failure rate and should be considered for early RT.

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Improved Outcomes in Acoustic Neuroma Patients Receiving Stereotactic Radiosurgery from a Single Neurosurgeon at a High-Volume Institution

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Purpose/Objective(s): Acoustic neuromas (AN), comprising 5-8% of all intracranial tumors, are benign and slow-growing. The most common pre-treatment presenting symptoms are hearing loss and tinnitus. Treatment options include observation, surgical resection, and radiation therapy. There is no consensus on optimal treatment for AN < 3.0 cm, nor on effectiveness and safety of stereotactic radiosurgery (SRS) compared to observation or surgery. Our single institution study examines post-SRS outcomes in patients seen by a high-volume neurosurgeon managing both surgery and radiation, following a paradigm of recommending SRS for AN < 2.2 cm and surgery for AN ≥ 2.2 cm for symptomatic patients.

Materials/Methods: This study examines outcomes in 424 AN patients receiving SRS from March 1998-March 2015 in an IRB-approved, single-institution, retrospective chart review. Maximum tumor diameter and date of radiographic progression were based on radiology reports. New or worsening hearing loss was determined by follow-up clinical notes and audiologic evaluations, as available. Kaplan-Meier analysis and a Cox proportional hazards model were used to evaluate time to new or worsening hearing loss and variables potentially associated with these outcomes.

Results: The cohort was 51% female, median age 59 years. Median follow-up was 32.5 months. Median tumor diameter at SRS date was 1.4 cm (14% ≥ 2.2 cm, 86% < 2.2 cm). Pre-SRS symptoms included hearing loss (93%), imbalance (disequilibrium, dizziness, or vertigo) (59%), tinnitus (57%), cranial nerve (CN) V impairment (12%), and CN VII impairment (8%). Among patients receiving SRS, 19% also received prior surgical resection. Serviceable hearing (Gardner-Robertson Grade I or II) existed in 64%. Post-SRS, among patients with pre-SRS symptoms, 75% had either stable or improved hearing, 88% had either stable or improved balance, 93% had either stable or improved tinnitus, 76% had either stable or improved CN V symptoms, and 90% had either stable or improved CN VII symptoms. No variables were associated with time to new or worsening hearing loss on Cox univariate regression analysis. At final follow-up, only two patients had tumor growth such that they required salvage treatment, and no patients had facial weakness requiring post-SRS surgical intervention.