



# Fractionated Stereotactic Radiotherapy for Pituitary Adenomas: Single-Center Experience with the BrainLAB Novalis System

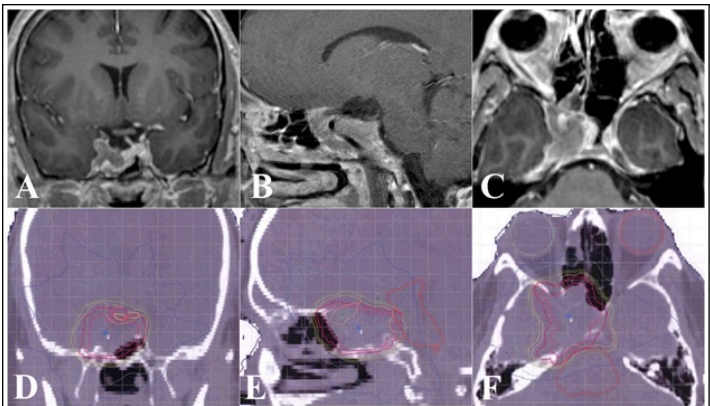
Sean M. Barber, MD; Bin S Teh MD; David S. Baskin MD  
Houston Methodist Neurological Institute, Houston, Texas

## Introduction

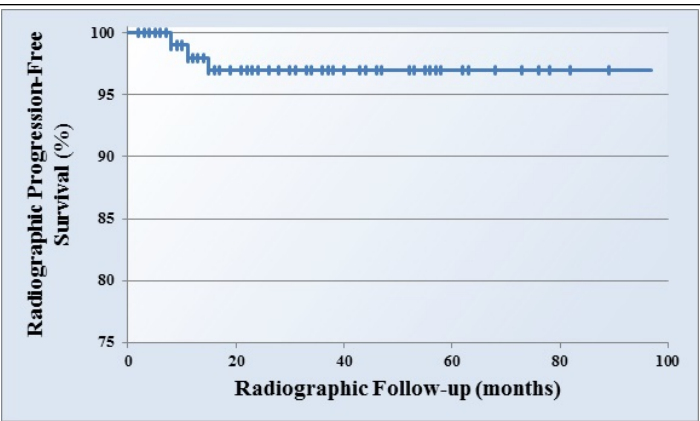
Fractionated stereotactic radiotherapy (FSRT) is a linear-accelerator-based radiotherapy technique that combines the precision of stereotactic radiosurgery (SRS) with the “tissue-sparing” advantage of dose fractionation.(1) Early results of post-operative FSRT for functional and non-functional pituitary adenomas appear promising, (2-3) but the majority of available evidence draws from small series with insufficient follow-up to draw meaningful conclusions.

## Methods

The study objective was to evaluate the long-term outcomes of a large series of patients undergoing FSRT for both functional and non-functional pituitary adenomas with the Novalis system (BrainLAB, Heimstetten, Germany) at our institution. One hundred consecutive patients underwent FSRT for a pituitary tumor at our institution between January, 2004 and June, 2013. Chart data for these 100 patients were retrospectively reviewed. Mean clinical follow-up was 66.6 months (range, 7.2 – 121.8 months).



(A – C) Post-operative, pre-radiotherapy MRI and (D – F) corresponding stereotactic radiotherapy planning target volume (PTV) definitions of a patient with a non-functioning pituitary adenoma who underwent FSRT after transsphenoidal tumor resection due to the presence of residual disease.



Kaplan-Meier survival curve illustrating the radiographic progression-free survival in 92 patients with pituitary adenomas (N = 90) or carcinomas (N = 2) after treatment with FSRT at our institution.

## Results

Mild, grade I acute adverse effects were observed during radiotherapy treatment in 47 patients (47%), and objective, persistent worsening of vision occurred in 3.5% after FSRT. Radiographic progression-free survival was 97% over a mean 31.4 months of radiographic follow-up (range, 1.9 – 96.8 months). Net growth occurred in only 2 patients, both of whom harbored pituitary carcinomas. Hormonal normalization was seen in 62.5% of patients with functional adenomas after FSRT, while 25% experienced partial hormonal control and 12.5% remained uncontrolled. New hormonal deficits were seen in 27% of patients after FSRT.

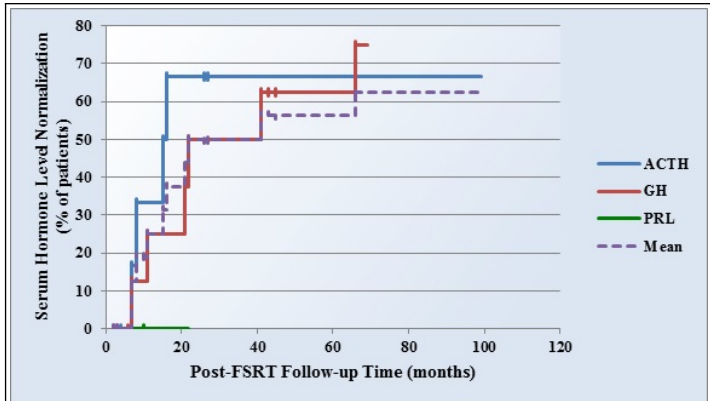
Radiographic and functional responses were inversely related to both tumor volume (Radiographic:  $R = -0.66$ ,  $P < 0.0001$ ; Functional:  $OR = OR = 0.849$ ,  $P = 0.025$ ) and time delay between surgical intervention and FSRT (Radiographic:  $R = -0.277$ ,  $P = 0.003$ ; Functional:  $OR = 0.99$ ,  $P = 0.005$ ). Radiographic ( $P = 0.006$ ) and functional ( $P = 0.027$ ) responses were also significantly better in radiation-naïve tumors.

## Conclusions

FSRT delivers radiographic and functional outcomes similar to those seen with SRS and conventional radiotherapy with less resultant toxicity. FSRT outcomes are most favorable in small pituitary adenomas (those < 3 cm in diameter) and when initiated promptly after surgical resection is complete.

## References

1. Shrieve DC, Kooy HM, Tarbell NJ, Loeffler JS. Fractionated stereotactic radiotherapy. Important advances in oncology. 1996;205-224.
2. Kim JO, Ma R, Akagami R, et al. Long-term outcomes of fractionated stereotactic radiation therapy for pituitary adenomas at the BC Cancer Agency. International journal of radiation oncology, biology, physics. Nov 1 2013;87(3):528-533.
3. Kopp C, Theodorou M, Poullos N, et al. Tumor shrinkage assessed by volumetric MRI in long-term follow-up after fractionated stereotactic radiotherapy of nonfunctioning pituitary adenoma. International journal of radiation oncology, biology, physics. Mar 1 2012;82(3):1262-1267.



Line-graph illustrating of the percentage of 16 patients with endocrine-active tumors who experienced normalization of serum hormone levels in the follow-up period after undergoing FSRT.