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## Abstract

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## Intracranial Motion during Frameless Stereotactic Radiosurgery

Mary-Mac Chown<sup>1</sup>, Danushka S. Seneviratne<sup>2</sup>, Alexander Hochwald<sup>3</sup>, Steven Herchko<sup>4</sup>, Sridhar Yaddanapudi<sup>5</sup>, Deanna Pafundi<sup>5</sup>, Sanjeet Grewal<sup>6</sup>, W. Christopher Fox<sup>7</sup>, Daniel M. Trifiletti<sup>8</sup>, Jennifer Peterson<sup>9</sup>

1. Radiation Oncology, Florida State University, Jacksonville, USA 2. Department of Radiation Oncology, Mayo Clinic, Jacksonville, USA 3. Clinical Trials and Biostatistics, Mayo Clinic Florida, Jacksonville, USA 4. Radiation Oncology, Mayo Clinic, Jacksonville, USA 5. Radiation Oncology, Mayo Clinic Florida, Jacksonville, USA 6. Neurosurgery, Mayo Clinic Florida, Jacksonville, USA 7. Neurological Surgery, Mayo Clinic Florida, Jacksonville, USA 8. Department of Radiation Oncology, Mayo Clinic Florida, Jacksonville, USA 9. Department of Radiation Oncology, Mayo, Jacksonville, USA

**Corresponding author:** Mary-Mac Chown, mec20a@fsu.edu

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## Abstract

## Objectives:

Gamma Knife Radiosurgery (GKRS) provides highly conformal and accurate delivery of radiation for treatment of intracranial lesions. The Gamma Knife Icon delivers frameless radiosurgery by tracking nasal tip motion from an infrared marker as a surrogate for intracranial motion using mask-based immobilization and a high-definition motion management system. Intrafraction motion during mask-based frameless radiosurgery remains a concern for safe and accurate delivery of ablative doses of radiation. The purpose of this study is to investigate the intrafraction motion associated with frameless Gamma Knife radiosurgery and assess treatment and patient specific factors that influence intracranial motion during treatment.

## Methods:

A retrospective study of patients treated with frameless GKRS between May 2018 and May 2022 was performed. Patient characteristics included age, sex, Body Mass Index (BMI), Eastern Cooperative Oncology Group performance status (ECOG), use of anxiolytics for treatment, malignant versus benign tumor, and history of smoking, anxiety/depression, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), or back pain. For each treatment, intrafraction average displacement, maximum displacement, treatment time, use of bite block, number of withdrawals, and clearance checks were collected. Generalized logistic regression models were employed to analyze the relationship between patient/treatment factors and displacement.

## Results:

113 patients underwent 397 consecutive frameless GKRS treatments. Of these, 85 patients (75.2%) had malignant tumors and 24 patients (21.2%) received anxiolytics prior to treatment. The median total treatment time was 29.7 minutes (range: 7-109). The median average displacement during treatment was 0.5 mm (range: 0.04-1.5 mm.) The median maximum displacement was 0.9 mm (range: 0.07-6.3 mm). Increased average displacement was significantly associated with increased BMI ( $p < 0.001$ ), higher ECOG ( $p = 0.004$ ), presence of back pain ( $p = 0.045$ ), increased treatment time ( $p < 0.001$ ), increased number of withdrawals ( $p < 0.001$ ), and need for clearance check ( $p = 0.002$ ). Increased maximum displacement was significantly associated with increased BMI ( $P < 0.001$ ), higher ECOG ( $p = 0.001$ ), malignant intracranial lesions ( $p = 0.021$ ), increased total treatment time ( $p < 0.001$ ), increased number of withdrawals ( $p < 0.001$ ), and need for clearance check ( $p = 0.005$ ).

## Conclusion(s):

Our data confirms frameless GKRS offers a minimally invasive and precise treatment with sub-millimeter accuracy. Factors associated with increased intrafraction motion include increased BMI, higher ECOG, malignant intracranial lesions, presence of back pain, increased treatment time, increased number of withdrawals, and the need for clearance check prior to treatment.