



Clinical Evaluation of Two Orthogonal Radiographic Imaging Systems for Image-Guided Stereotactic Radiosurgery

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INTRODUCTION

Stereotactic Radiosurgery (SRS) has become a common treatment technique to manage brain metastasis and other brain tumors. The delivery of SRS treatment requires submillimeter accuracy, demanding accurate image guided setup to facilitate accurate delivery of the treatment. Our institutional SRS pre-treatment verification imaging protocol calls for 2-D orthogonal radiographic imaging followed by 3-D volumetric imaging with CBCT. Two orthogonal radiographic imaging systems are available for imaging guidance of SRS treatment, ExacTrac (ET, BrainLab, Munich, Germany) and On-Board Imager (OBI, Varian Medical Systems, Palo Alto, CA). The purpose of this study is to evaluate the performance of two orthogonal radiographic imaging systems for SRS pre-treatment patient positioning verification.

METHOD

We retrospectively reviewed the images of SRS patients treated in 2019 to assess the performance of ET and OBI in comparison with CBCT.

- 96 SRS patients treated in 2019
- 103 OBI+CBCT imaging sessions performed for 37 patients
- 231 ET+CBCT imaging sessions performed for 59 patients

Using CBCT as the gold standard, the additional shifts required by CBCT after the initial shifts determined by OBI or ET imaging were analyzed and compared.

RESULTS

Figure 1. Scatter Gram of Additional CBCT Shifts required after initial shifts by ExacTrac or OBI

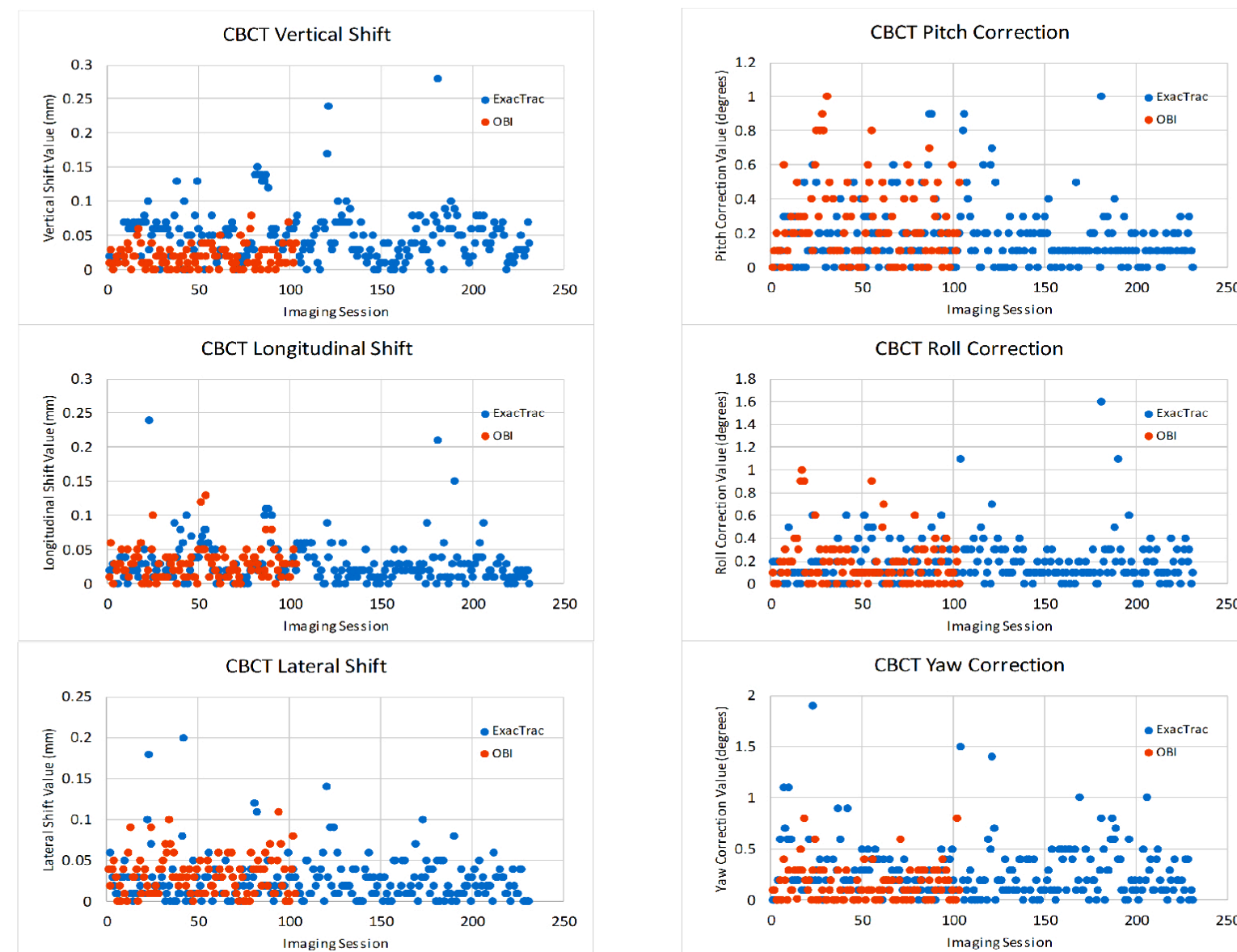


Table I. Statistics of Additional Shifts by CBCT After Initial Shifts by ExacTrac or OBI

	ExacTrac						OBI					
	Vrt (cm)	Lng (cm)	Lat (cm)	Pitch (dgr)	Roll (dgr)	Rot (dgr)	Vrt (cm)	Lng (cm)	Lat (cm)	Pitch (dgr)	Roll (dgr)	Rot (dgr)
Mean	0.049	0.029	0.027	0.18	0.19	0.27	0.021	0.029	0.032	0.26	0.19	0.15
Standard Deviation	0.038	0.031	0.028	0.18	0.19	0.27	0.017	0.023	0.024	0.23	0.21	0.17
Maximum	0.280	0.240	0.200	1.00	1.60	1.90	0.080	0.130	0.110	1.00	1.00	0.80

RESULTS

The means and standard deviations of CBCT shift are as follows.

Post Exactrac Imaging Shifts

Vertical 0.49 ± 0.38 mm

Longitudinal 0.29 ± 0.31 mm

Lateral 0.27 ± 0.28 mm

Pitch $0.18 \pm 0.18^\circ$

Roll $0.19 \pm 0.19^\circ$

Yaw $0.27 \pm 0.27^\circ$

Post OBI imaging shifts

Vertical 0.21 ± 0.17 mm

Longitudinal 0.29 ± 0.23 mm

Lateral 0.32 ± 0.24 mm

Pitch $0.26 \pm 0.23^\circ$

Roll $0.19 \pm 0.21^\circ$

Yaw $0.15 \pm 0.17^\circ$

OBI performed better with vertical and yaw corrections ($p < 0.05$) while ET performed better with lateral and pitch corrections ($p < 0.05$).

CONCLUSIONS

2-D orthogonal radiographic imaging with ET and OBI both yielded reasonable positioning accuracy for SRS treatment compared to 3-D volumetric CBCT imaging. ExacTrac performed better in lateral and pitch corrections ($p < 0.05$) than OBI while OBI performed better in vertical and yaw corrections ($p < 0.05$) than ExacTrac.