



A retrospective evaluation of intra-fraction patient mobility with Brainlab ExacTrac in SRS treatments

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Purpose

Over the past few years, stereotactic radiosurgery (SRS) has become the gold standard in the clinical management of patients with single or multiple brain metastases. At our center, four arcs are realized with non-coplanar couch angles for SRS treatments. In order to ensure correct patient positioning throughout the entire treatment, intra-fraction IGRT is performed between each arc with the Brainlab stereoscopic ExacTrac kV system (EXT). **The purpose of this study is to evaluate intra-fraction patient mobility by retrospectively analyzing 6D couch shifts on a large cohort of patients.**

Materials and Methods

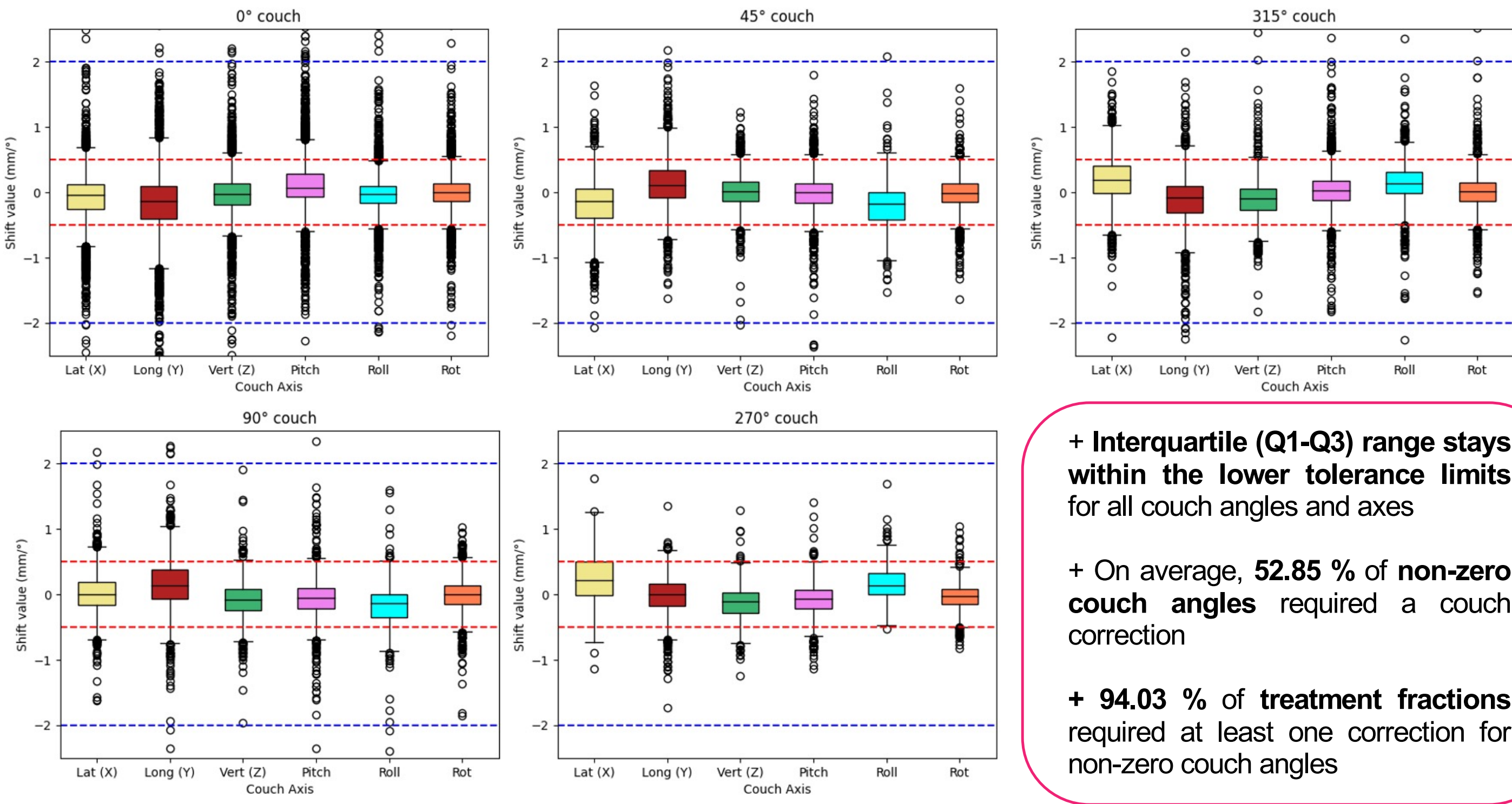
During SRS treatment, patient positioning is verified using EXT after patient installation and for non-zero couch angles after each arc. 6D couch shifts calculated by EXT are applied if they exceed tolerance limits (0.5 mm for translational shifts and 0.5° for rotational shifts). For shifts exceeding 2 mm or 2°, the patient is repositioned. Treatment is delivered only when residual errors fall within tolerance limits.

To assess patient mobility during the treatment delivery, we analyzed all the couch shifts for SRS treatments in EXT database using an in-house Python script. The extent and distribution of patient shifts were quantified in all six dimensions (6D). To evaluate the importance of imaging for non-coplanar treatment beams, the percentage of applied shifts for non-zero couch angles and the percentage of treatment fractions requiring at least a correction for non-zero couch angle were calculated.

In this study, we examined a cohort of 420 patients, leading to a total of 1507 SRS treatment fractions.

Results

The results below illustrate the distribution of patient shifts in 6D for each couch angle. The red and blue lines correspond to the lower shift limits ($\pm 0.5 \text{ mm}/^\circ$) and upper shift limits ($\pm 2 \text{ mm}/^\circ$) respectively.



Conclusion

This retrospective study has shown the clear utility of the Brainlab ExacTrac kV system in intra-fraction verification of patient positioning. It highlights that despite the use of patient immobilization systems, there is still a possibility of a patient positioning error beyond acceptable limits. This possibility needs to be accounted for in SRS treatments. A future study will focus on the underlying causes of these shifts to conclude if they originate from a patient movement or couch movements during rotations.