Purpose:
Frameless Stereotactic Radiosurgery requires <1mm positional accuracy. We quantified the accuracy and precision of the IGRT treatment process for the Elekta Infinity using a comprehensive phantom-based QA procedure. The IGRT process was evaluated for both MV planar imaging and kilovoltage cone beam computed tomography (kVCBCT).

Methods:
A CIRS Radiosurgery head phantom with a film dosimetry insert was used to measure dose distributions in three anatomic planes. Once the phantom was properly aligned on the treatment couch, a series of offsets were applied to the position of the phantom; intentional misalignments of ±5mm in the lateral, longitudinal, and axial directions were applied. Prior to treatment, one of the IGRT modalities was used, and the calculated realignment values were applied to the phantom position. An isocentric seven-field treatment plan with a prescription of 3Gy per fraction was delivered to the phantom. The delivered dose distributions were analyzed and compared to the calculated dose distributions from the Pinnacle(v.8.0m) treatment planning system. Two metrics were analyzed from the film: (1) dose profile positional alignment error at the 70% dose level and (2) directional mismatch of dose profile edges at the 80% dose points.

Results:
The largest positional alignment errors occurred along the inferior-superior axis [0.64 ± 1.01mm]. This was possibly due to slack in the couch along this direction – the couch tended to shake slightly along this axis. Similarly, the shifts in the 80% dose points were worst along the inferior-superior axis [80%(Inf) = -0.71 ± 0.91mm; 80%(Sup) = -0.89 ± 1.17mm].

Conclusions:
Our evaluation indicates the Elekta Infinity does not have sufficient positional accuracy for frameless Stereotactic Radiosurgery, but its positional accuracy is more than suitable for conventional radiotherapy. For all cases, using kVCBCT for phantom alignment resulted in more conformal dose coverage than using MV Planar imaging.

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