Purpose: To compare the ability of Brainlab ExacTrac (Brainlab AG, Feldkirchen, Germany) x-ray (XRAY), Brainlab infrared array (IR), cone beam CT (CBCT), and AlignRT (VisionRT Ltd., London, UK) to accurately measure patient displacement during stereotactic radiosurgery (SRS) on a Varian TrueBeam STx (Varian Inc, Palo Alto, CA).

Methods and Materials: A CT scan was obtained for a custom skull phantom placed in a Brainlab frameless SRS immobilization system with the Brainlab CT localizer box attached. A generic plan was created in Brainlab iPlan and sent to Brainlab ExacTrac, to AlignRT, and to the TrueBeam.

The skull phantom was set-up on the TrueBeam and positioned to isocenter using XRAY. Next, CBCT and IR were acquired and evaluated to determine baseline positions for these methods. A new AlignRT reference surface was acquired as baseline. The phantom was then displaced 2 mm in the vertical, lateral, and longitudinal dimensions using the TrueBeam couch (the couch tolerance is 0.1 mm in each dimension). New XRAY, IR, CBCT, and AlignRT data was acquired in this position.

Results: Initially, all methods found that the phantom was positioned with < 0.3 mm accuracy. After the shifts, XRAY suggested shifts were 2.0, 2.1, 1.8 mm in the vertical, longitudinal, and lateral dimensions, respectively. The IR shifts were 1.7, 2.6, 2.1 mm. The CBCT shifts were 1.8, 1.8, 2.1 mm. The AlignRT shifts were 2.2, 1.6, 1.4 mm.

Conclusion: The internal XRAY and CBCT methods produced slightly better agreement with the table shifts. The external IR and AlignRT methods were less accurate, but still gave agreement of <= 0.6 mm. Note, the AlignRT cameras did not produce a clean surface off of the phantom. Improved accuracy is expected from a skin surface. This is preliminary work, more extensive study is needed to evaluate these methods.