Purposes: A chair, coupled to a robotic patient positioning system (PPS) was manufactured to treat an intracranial tumor in a proton incline beam-line system. Treating patients in the seated position as accurately and efficiently as a treatment table requires the essential functions of isocentric rotation and a weight-sagging-correction algorithm for positioning patients in the seated position.

Methods and Materials: The chair design incorporated a down-slope arm to achieve the desired beam-line height. To overcome this limitation of only 125 degree rotation on PPS, five indexed positions of the seat-base-plate (SBP) were implemented. An in-house developed optical tracking system using a six degree-of-freedom optical camera system was used to align the treatment room coordinate system with the chair coordinate system at all SBP positions. Furthermore, this optical tracking system quantified the sagging effect due to both the height and weight of a variety of patients.

Results: The optical tracking system can measure accuracy of 0.1 degree and 0.1 mm. The SBP rotating axis was aligned within 0.1 degree to PPS rotating axis. A residual precession of chair rotation was found to be an ellipse with long axis of 2.0 mm and short axis of 1.0 mm. An additional 0.75 mm deviation occurred between rotating of SBP and PPS axes. Sagging tilt of 0.6 degree was found on the SBP for the home position for every additional 162 lbs load. This resulted in a 1.1 cm shift (0.65 cm forward and 0.87 cm) for an isocenter 90 cm away from the SBP plate.

Conclusions: Using in-house developed optical tracking system, the overall maximum displacement of treatment chair system from isocenter is within 3.0 mm with known sagging characteristics. This characterization is essential to reduce the total treatment time and limited the number of X-rays required for accurate patient alignment in the seated position.

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N/A