

Correlation Study of Mechanical Accuracy and Longitudinal Location of a Six Degrees-of-Freedom Couch

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INTRODUCTION

Protura™ 6D couch (CIVCO, Coralville, IA, USA) has the limitation of the total correction magnitude being 3 mm/3°. Even though the maximum pitch, roll, yaw angle that can be compensated for by the Protura pedestal was 3°, the clinically achievable compensation could be significantly reduced depending on the longitudinal location of the pedestal. During the two years of clinical applications using the Protura system, we have noticed that the accuracy of position adjustments depended on the couch's longitudinal positions. This work aims to address these concerns.

AIM

The purpose of this study is to evaluate the mechanical accuracy of Protura™ 6D couch (CIVCO, Coralville, IA, USA) along with its longitudinal positions and its dosimetry correlation using both OBI/CBCT and StereoPHAN/SRS MapCHECK (SRSMC).

METHODS

The distance between the origin of pedestal rotational axes of the Protura System and Linac iso-center was set at various values: at each position, CBCT image of StereoPHAN/SRSMC was acquired and fused with the planned CT image, calculated 6D shifts were applied to the phantom. After phantom's positions were adjusted, the accuracy of each shift was evaluated by the following two separate methods: 1) A second CBCT of the phantom was acquired and its position was compared with its planned CT image, the differences were recorded as mechanical errors; 2) A beam dosimetry was obtained through SRSMC measurement at those shifted positions, and its differences from the planned dose distribution were considered dosimetry errors incurred by the Protura system. The couch longitudinal positions were set to 10 cm interval.



Fig.1 Motion of a Protura™ 6 degrees-of-freedom couch



Fig. 2. StereoPHAN/SRSMC used in measurements

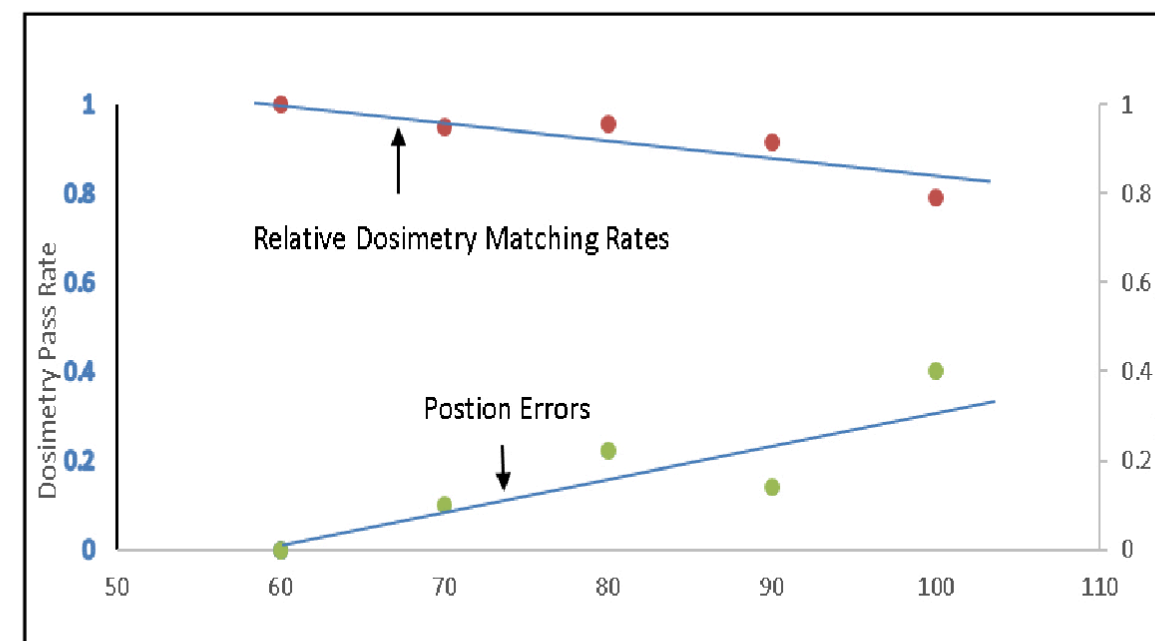


Fig 3. Position errors and relative Gamma passing-rate change with couch longitudinal position

RESULTS

Both mechanical and dosimetry errors have shown gradual increases when the couch longitudinal distances (origin of pedestal rotation and iso-center) were reduced (moving toward the Linac). Although most mechanical errors were in the range of 1-2 mm, a large error of about 4 mm was indeed observed when the couch moved closer to the far end of its limit close to the gantry. The results from dosimetry measurements were consistent with the above observations: Gamma (3%/1mm) passing rates were decreased gradually to its lowest value after a 40-cm pedestal longitudinal shift.

CONCLUSIONS

Phantom measurements showed small gradual increases in positioning errors from the Protura System when its longitudinal distances are increased. The source of these systemic deviations was not clear and further investigation is needed.

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