

The Pivotal Impact of Optimizing Target Margins and Reducing Setup Errors on Enhancing Clinical Outcomes and Precision in Cervical Cancer Radiotherapy Using Electronical Portal Image Device

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Abstract : Background: This study highlights the impact of optimizing target margins by minimizing setup errors in cervical cancer radiotherapy through electronic portal imaging device, aiming to improve treatment accuracy and patient outcomes. These findings are crucial for refining treatment protocols and enhancing the safety and effectiveness of radiation oncology practices. As a groundbreaking initiative within our department, this work marks a major advancement in treatment optimization and will be disseminated to other radiotherapy centers, encouraging the adoption of consistent and improved radiotherapy practices. Materials and Methods: The study involved 20 cervical cancer patients treated between January 30 and September 30, 2024, using knee and foot fixed supports for immobilization. Treatment setups were verified with electronic portal imaging and delivered via an Elekta linear accelerator to enhance radiotherapy precision. Displacement analysis used bony landmarks to assess setup errors, guiding the calculation of safety margins based on ICRU-62 guidelines and Stroom's and Van Herk's formulas. Results: The study revealed systematic errors of up to 0.22 cm and random errors of 0.74 cm along the X-axis, 0.2 cm and 0.08 cm along the Y-axis, and 0.18 cm and 0.08 cm along the Z-axis. Based on these findings, the calculated CTV-PTV margins for the X, Y, and Z axes were 0.61 cm, 0.57 cm, and 0.51 cm, respectively, using Van Herk's formula; 0.5 cm, 0.46 cm, and 0.42 cm with Stroom's formula; and 0.23 cm, 0.22 cm, and 0.2 cm according to ICRU-62 guidelines. Considering these calculations, a 6 mm safety margin is recommended as optimal. Discussion: While electronic portal imaging device improves radiotherapy precision, it has limitations, including limited field of view, difficulty with soft tissue visualization, and insufficient resolution for small errors. Patient variations and setup errors occurring after imaging further complicate safety margin calculations. Time, image quality, and radiation dose concerns also pose challenges. Integrating electronic portal imaging device with advanced imaging techniques like 3D imaging can enhance treatment accuracy. Conclusion: this study highlights the significance of a 6 mm safety margin, showing that image guided verification with electronic portal imaging enhances accuracy, reduces errors, and improves the precision of pelvic radiotherapy.

Keywords : cervical cancer, precision, PTV margins, radiotherapy, setup errors

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