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A Simple Daily QA Method for PBS Proton Therapy Using Patterned Phantoms and EBT3 Film

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Purpose
This study aimed to develop an efficient daily quality assurance (QA) program for pencil beam scanning (PBS) proton therapy, using custom-designed patterned phantoms and EBT3 film to measure and visually confirm proton range and spot position.

Methods
Two polymethylmethacrylate (PMMA) phantoms were used: a spiral step pattern for proton range verification and a round pattern for spot position verification.
For range measurements, the step pattern phantom with EBT3 film evaluated five proton beam energies (103-200 MeV). Sensitivity was assessed by varying measurement depth and spot position by ±0.1cm and ±0.2cm. Spot position verification used the round pattern phantom at 119 MeV with 140 MU and 280 MU at 10 cm depth. The phantom was shifted ±2mm laterally. Irradiated films were scanned and analyzed to detect spot position changes.

Results
The step pattern method visually differentiated proton range variations across energies. Grayscale analysis of irradiated films showed distinct patterns corresponding to depth and position variations, allowing easy identification of range deviations.
In round pattern experiments, clear changes in beam profile graphs were observed with 2mm offsets. Spot position changes were more pronounced at 280 MU compared to 140 MU, suggesting increased MU enhances verification accuracy.

Conclusion
This QA method using patterned phantoms and EBT3 film enables quick, accurate verification of proton range and spot position in PBS proton therapy. The round pattern phantom showed high sensitivity for spot position verification, indicating effectiveness for daily QA.
As heavy ion therapy systems are introduced, this patterned phantom technique could be adapted for developing Daily QA protocols. This approach offers a time-efficient alternative to complex measurement techniques, suitable for routine QA checks in both proton and heavy ion therapy.

Paper submission Plan

Yes

Best Presentation

Contribution track

ICABU WG4. Applications of Particle Beams

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