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abstract

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Hamid Jamil, Asdar Ul Haq

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abstract

Development and Validation of a Low-Cost Prostate Brachytherapy Ultrasound QA Phantom Based on AAPM TG-128 Protocol

Author: Hamid Jamil¹, Asdar Ul Haq¹

Affiliation: ¹Department of Radiation Oncology, Sindh Institute of Urology and Transplantation, Karachi, Pakistan

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Introduction: Ultrasound image guidance and quality assurance (QA) of imaging and needle placement are important for safe and accurate prostate brachytherapy. However, the QA phantoms recommended by AAPM TG-128 are very costly and difficult to obtain in low-resource settings. This study aimed to design and test a low-cost, tissue-like ultrasound phantom that follows the main requirements of TG-128.

Methodology: The phantom was made using a agar-based gel with added silica powder, graphite and glycerol to match soft-tissue ultrasound properties. Simple geometric structures, including spherical and cylindrical targets, were incorporated to represent key anatomical regions relevant to prostate brachytherapy QA, as recommended in AAPM TG-128. The phantom was evaluated on a clinical transrectal ultrasound system to check image quality, geometric accuracy, and repeatability of needle insertion. Distance measurements, contrast visibility, and needle tracking were compared with TG-128 recommendations.

Results: Ultrasound images showed clear visibility

of all internal structures. The size measurements were within ± 1 mm of the intended design. Repeated needle insertions showed a consistent accuracy within 1.5 mm. The phantom remained stable for routine QA use, and the total fabrication cost was very low compared with commercial phantoms.

Conclusion: This study shows that a simple, low-cost prostate brachytherapy ultrasound phantom can be made locally while still meeting key TG-128 requirements. It provides reliable performance for QA, commissioning, and training. Future work will focus on making longer-lasting versions using stronger gels or urethane materials, as well as using replaceable inserts to increase durability.

Conflict of interests: The authors declare no conflict of interests.

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