

Clinical Validation of Open-Source Pylinac Platform for Gamma Analysis in Patient-Specific Quality Assurance



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INTRODUCTION

- Open-source solutions represent a transparent and economical alternative to commercially available patient-specific quality assurance (PSQA) platforms.
- This study aims to validate open-source Pylinac based gamma analysis by comparing its performance against established commercial QA platforms, Mobius™ and ArcCHECK™, across multiple treatment sites.

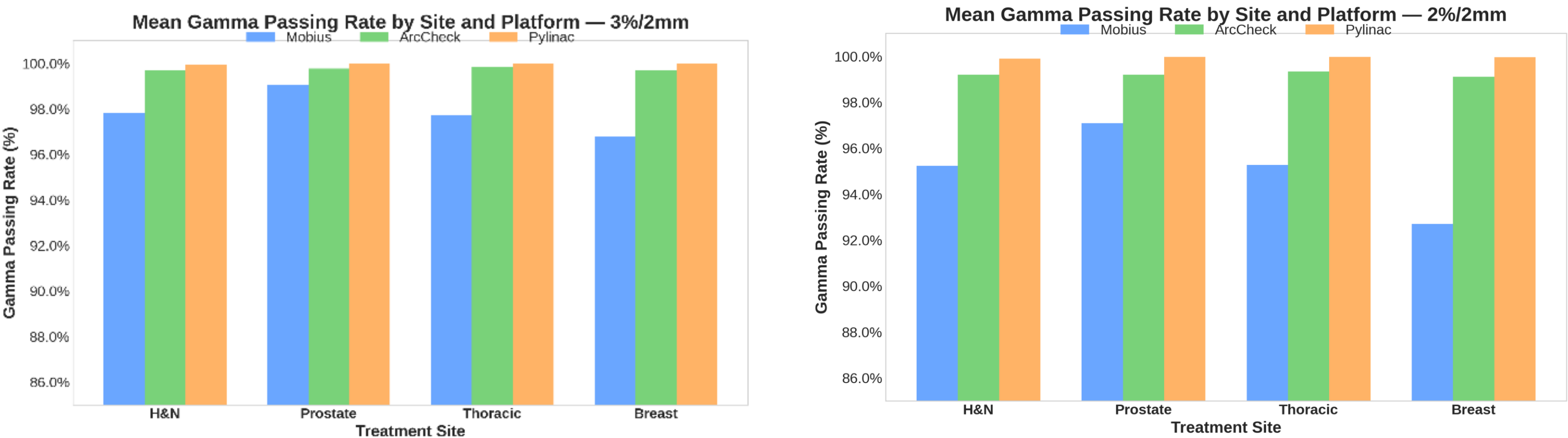
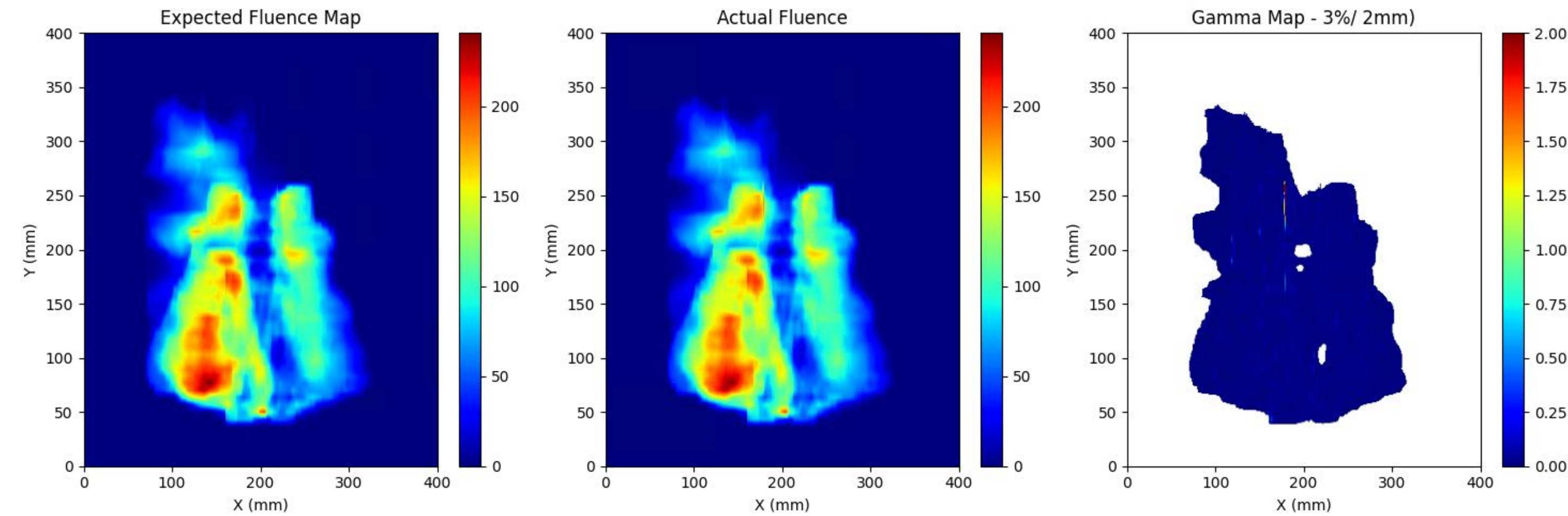
METHODS

- Twenty VMAT treatment plans delivered on a TrueBeam™ linear accelerator were retrospectively analyzed, including five patients each from head and neck, thoracic, prostate, and breast/chest wall sites (IRB No. RCR03-0400).
- Fluence maps were reconstructed from the TrueBeam™ trajectory log files using Pylinac platform.
- Expected and delivered fluence maps were generated by projecting the recorded MLC leaf positions, jaw settings, gantry angles, and monitor unit (MU) delivery information onto a fluence plane.
- Gamma analysis was performed between the reconstructed delivered fluence and the reference fluence, and the resulting passing rates were compared with Mobius™ and ArcCHECK™ dose-based QA results.
- Dose Analyses were performed using 3%/2 mm and 2%/2 mm criteria with 10% dose threshold.
- Gamma passing rates were evaluated by comparing Pylinac versus Mobius™ and Pylinac versus ArcCHECK™ across four treatment sites and under both gamma analysis criteria.

CONCLUSIONS

- Pylinac based gamma analysis demonstrated clinically acceptable agreement with the commercially available QA platforms, Mobius™ and ACarcCHECK™ across all treatment sites.
- These results warrant further investigation using additional verifications to support the full integration of Pylinac based PSQA into routine clinical practice.

RESULTS



- The mean gamma passing rates for four treatment sites, H&N, Prostate, Thoracic, and Breast/ChestWall, evaluated across three QA platforms under gamma criteria: 3%/2 mm and 2%/2 mm.

- Pylinac-derived expected and actual fluence distributions along with the corresponding gamma analysis (3%/2 mm and 10% threshold) of a H&N plan.
- The gamma map is dominated by deep blue regions, indicating excellent agreement with no clinically significant gamma failures. White regions correspond to out-of-field areas with fluence below the 10% threshold.
- Mean gamma passing rates for the Pylinac platform were $99.98 \pm 0.04\%$ for 3%/2 mm and $99.96 \pm 0.07\%$ for 2%/2 mm.
- ArcCHECK™ results were similarly higher, with mean gamma passing rates of $99.76 \pm 0.26\%$ for 3%/2 mm and $99.21 \pm 0.57\%$ for 2%/2 mm.
- Mobius™ values were lower, averaging $97.9 \pm 1.55\%$ for 3%/2 mm and $95.15 \pm 2.9\%$ for 2%/2 mm.

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