

High-Precision Irradiation using Hepatic Gold Anchor in Pancreatic Carbon-Ion Radiotherapy (PTCOG-AO2025-ABS-0045)



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Background

Carbon-ion radiotherapy (CIRT) delivers conformal tumor dosing while sparing organs-at-risk (OAR). However, density variations and interfractional motion can reduce target coverage and increase OAR dose. Interfractional target motion is typically corrected using marker matching (MM) or target matching (TM). However, due to the anatomical proximity of the pancreas to the gastrointestinal tract and major vessels, percutaneous puncture is challenging and carries a high risk of organ or vascular injury. Furthermore, metal artifacts from fiducial markers placed adjacent to the pancreas distort CT values, preventing accurate calculation of the beam stop position. Consequently, the spread-out Bragg peak formation position may deviate from the tumor location, potentially reducing the tumor dose. TM performed using a computed tomography (CT) scanner also limits treatment efficiency. This study aimed to correct interfractional target motion and improve target coverage in pancreatic cancer CIRT by implanting fiducial markers in hepatic segments 5 or 6.

Methods

Twenty patients with implanted fiducial markers in hepatic segments 5 or 6 who underwent liver cancer CIRT at our hospital were selected. A simulation study evaluated the effect of MM on correcting interfractional target motion in pancreatic cancer CIRT. The initial planning CT and in-room CT images were used for bone matching (BM), liver-dome matching (LM), TM, and MM. Correlations between motions of target and fiducial marker were analyzed, and fractional dose distributions were calculated. Variations in clinical target volume (CTV) coverage (Δ CTV V95%) were compared across each matching method.

Results

A strong correlation was observed between motions of target and fiducial marker (**Fig. 1**). Median Δ CTV V95% values were -4.68% , -3.97% , -1.07% , and -1.69% for BM, LM, TM, and MM, respectively (**Fig. 2**). TM and MM significantly improved target coverage compared to BM and LM. MM effectively corrected interfractional target motion, achieving coverage comparable to TM. The MM approach proposed in this study effectively corrected interfractional target motion, achieving a target coverage comparable to that of TM.

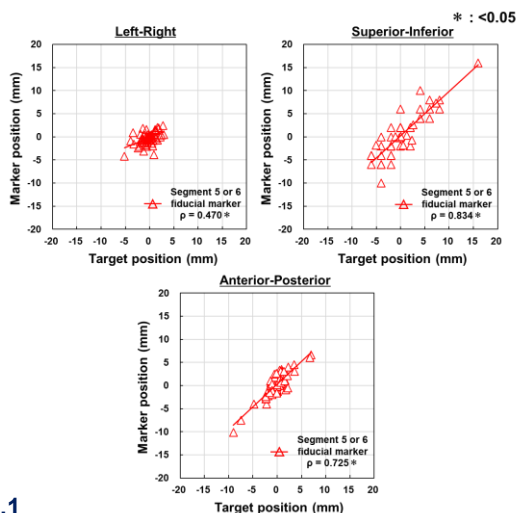


Fig.1

Correlation between motions of target and fiducial marker.

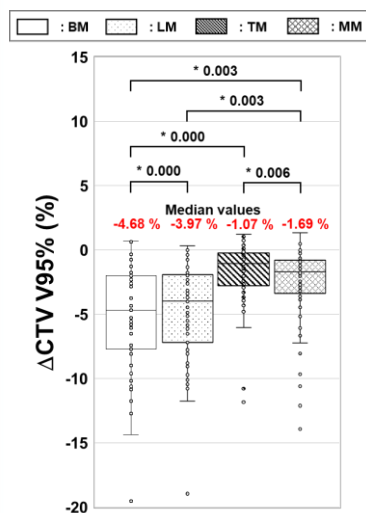


Fig.2 Variations in Δ CTV V95%.

