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2 **Improvement of registration accuracy in accelerated partial breast**
3 **irradiation using the point-based rigid-body registration algorithm for**
4 **patients with implanted fiducial markers**

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16 **Short running title**

17 Manual vs. algorithm-based registration in image-guided APBI

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25 **Conflicts of interest**

26 None

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32 **Abstract**

33 **Purpose:** To investigate image-registration errors when using fiducial markers with a manual
34 method and the point-based rigid-body registration (PRBR) algorithm in accelerated partial
35 breast irradiation (APBI) patients, with accompanying fiducial deviations.

36 **Methods:** Twenty-two consecutive patients were enrolled in a prospective trial examining
37 10-fraction APBI. Titanium clips were implanted intraoperatively around the seroma in all
38 patients. For image registration, the positions of the clips in daily kV X-ray images were
39 matched to those in the planning digitally reconstructed radiographs. Fiducial and gravity
40 registration errors (FREs and GREs, respectively), representing resulting misalignments of the
41 edge and center of the target, respectively, were compared between the manual and
42 algorithm-based methods.

43 **Results:** In total, 218 fractions were evaluated. Although the mean FRE/GRE values for the
44 manual and algorithm-based methods were within 3 mm (2.3/1.7 and 1.3/0.4 mm, respectively),
45 the percentages of fractions where FRE/GRE exceeded 3 mm using the manual and
46 algorithm-based methods were 18.8/7.3% and 0/0%, respectively. Manual registration resulted
47 in 18.6% of patients with fractions of FRE/GRE exceeding 5 mm. The patients with larger clip
48 deviation had significantly more fractions showing large FRE/GRE using manual registration.

49 **Conclusions:** For image registration using fiducial markers in APBI, the manual registration
50 results in more fractions with considerable registration error due to loss of fiducial objectivity
51 resulting from their deviation. We recommend the PRBR algorithm as a safe and effective
52 strategy for accurate, image-guided registration and PTV margin reduction.

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