Title: The effect of patient motion on functional tumor volume measured by DCE breast MRI in the prediction of pCR for neoadjuvant therapy

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Purpose
To investigate the effect of patient motion during DCE-MRI acquisition on functional tumor volume (FTV) in the prediction of pathologic complete response (pCR) for neoadjuvant therapy.

Materials and Methods
A sub-cohort (n=376) of patients enrolled in two graduated drug arms of the I-SPY 2 clinical trial were included in this study. Each patient had four DCE-MRI scans: pre-treatment (T0), after 3 weeks of the first regimen (T1), between two regimens (T2), and before surgery (T3). FTV was calculated as the sum of voxel volumes that met the enhancement thresholds within a 3-dimentional (3D) region-of-interest. Percentage changes in FTV from T0 to T1, T2, and T3 were calculated. Patient motion was visually evaluated for all MRIs by three readers. The area under the ROC curve (AUC) was used to evaluate the prediction of percentage changes in FTV from T0 to T1, T2, and T3 for pCR.

Results
AUCs for FTV to predict pCR with and without motion exams were calculated at each treatment time point for the full cohort (all subtypes included) and each HR and HER2 defined breast cancer subtype. From Figure 1, we can see steady increase of AUCs by excluding exams severe and additional minor exams were observed in the full cohort at T2. In subtypes, the steady increase pattern was also observed at T2 for HR+/HER2- and T1 for HR-/HER2+. By excluding exams with severe motion, AUCs increased in all plots except for full cohort and triple negatives at T3, especially in HR-/HER2+ subtype. Minor motion did not shown the impact on AUCs for HR+/HER2+ and triple negative cohorts. Big difference in AUCs were observed for HR+/HER2- at T2 (0.74 for all and 0.95 after excluded exams with any motion) and HR-/HER2+ at T1 (0.69 for all and 0.87 after excluded exams with any motion).

Conclusion
Motion during the DCE-MRI scan can affect the predictive performance of FTV. Among breast cancer subtypes, HR+/HER2- and HR-/HER2+ benefit more from excluding cases with motion cases than HR+/HER2+ and triple negative cancers.

Clinical Relevance
This study showed that even slight motion can affect the predictive performance of DCE-MRI, especially in HR+/HER2- and HR-/HER2+ breast cancer subtypes.
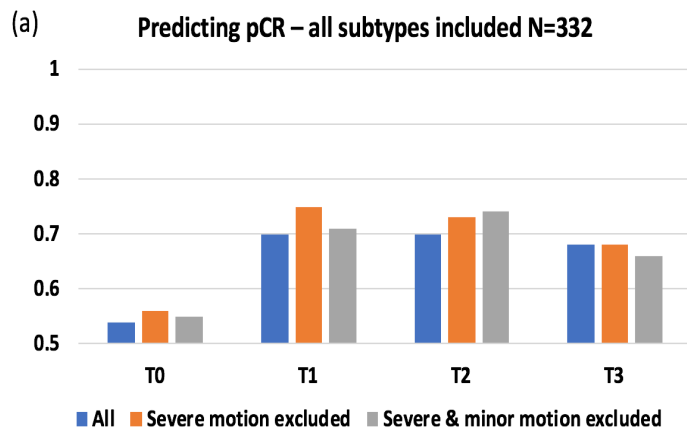
Figure 1. Plots of AUC values estimated from patient cohorts with or without motion cases excluded for the full (all subtypes included; a), HR+/HER2- (b), HR+/HER2+ (c), HR-/HER2- (d), and HR-/HER2+ (e). AUCs for HR+/HER2- at pre-treatment were not shown because all values were lower than 0.5.