

**Presenter:** Dinesh Sundarakumar, MD

**Title of Abstract:** Validation of image registration for motion-correction in 3D dynamic contrast enhanced liver

**Abstract:** MRI; impact on temporally subtracted images

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**Modality:** MR

**Organ System:** GI

**Intro:** The liver undergoes considerable displacement due to respiratory motion and elastic deformation. This leads to variation in the position of the liver during breath-hold examinations and subsequent misregistration on the subtraction images (SI). Advantages of SI in characterizing small and subcapsular lesions have therefore been limited due to misregistration artifacts.

**Purpose:** Quantify hepatic displacement occurring between different breath-holds in multiphasic contrast-enhanced MRI of the liver, and assess its impact on subtracted images (SI) before and after automated registration for motion correction.

**Methods Used:** In an IRB approved retrospective analysis of 25 cirrhotic patients (20 males/5 females, 35-72 years), 32 small conspicuous cysts were used as markers to measure relative displacement over the dynamic scan series. Using the automated CADStream™ (Merge, Chicago) 3D deformable registration algorithm, registered base and SI were created. The displacement of each T1 hypointense lesion was calculated pre vs. post registration using the venous phase as the baseline. In these registered/ non-registered SI, 25 co-existing treated hepatocellular carcinomas were subjectively analyzed for image quality and subtraction artifacts on a 5-point scale. Paired T-test and Wilcoxon signed rank analysis was performed on the displacement and image quality data respectively.

**Results of Abstract:** The average total lesion displacement was significantly less for registered vs. non-registered images; displacement (non-contrast, arterial, delayed) 3.8, 3.1, 4.4 mm vs. 2.3, 1.5, 1.3 mm respectively ( $p < 0.003$ ). Cranio-caudal displacement was greatest, averaging 2.4 vs. 0.8mm; registered vs. non-registered respectively. Band artifact width decreased from 0.49 to 0.23mm, 0.58 to 0.24mm, 0.49 to 0.27mm for arterial, venous, delay subtractions respectively ( $p < 10^{-6}$ ). Overall subtraction artifacts were significantly lesser (4.7 vs. 3.4,  $p < 10^{-18}$ ) with an improved confidence in the characterization of HCC (4.7 vs. 3.5,  $p < 10^{-17}$ ) in the registered versus non-registered SI.

**Discussion:** Significant hepatic displacement occurs during dynamic MRI, leading to subtraction artifacts. Utilizing a 3D registration algorithm, subtraction quality is significantly improved with only minimal registration-related artifacts.

**Scientific and/or Clinical Significance?** Misregistration artifacts in dynamic CE liver MRI can be mitigated by automated image registration and improves diagnostic confidence for T1-bright lesions such as treated HCC.

**Relationship to existing work** Characterizes the hepatic displacement between breath-holds and estimates the impact of registration on SI quality.