Personalized biomechanical modeling of prostate deformation based on elastography for MR-TRUS image registration
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Purpose To evaluate the clinical significance of personalized biomechanical modeling of prostate deformation based on ultrasound elastography for magnetic resonance imaging (MRI)-Transrectal Ultrasound (TRUS) image registration.

Methods A total number of 35 patients and 5 commercial prostate phantom were imaged via transrectal ultrasound elastography, TRUS and MRI at the first affiliated hospital of SYSU from June 2017 to December 2018. We propose a personalized biomechanical model via the patient-specific ultrasound elastography for the deformable registration of prostate MR and 3D TRUS images. The registration accuracy was evaluated by the target registration error (TRE) and also the t-test was conducted to validate the statistical significance of our results.

Results All the 35 sets of patient data, as well as the phantom data, were successfully registered. The TRE value of the phantom data was 1.69mm. The mean TRE value of 35 patients was 1.29 mm, compared with the 2.56 mm TRE value of the registration method without patient-specific biomechanical properties via elastography, was approximately 48% lower. The improvement was with statistical significance validated by t-test (p-value was 1.45e-8).

Conclusions Personalized biomechanical modeling of prostate deformation based on ultrasound elastography for MR-TRUS image registration is with clinical significance and is a promising way to provide more quality guidance and improve the accuracy of prostate biopsy.