Purpose:
An accurate determination of stage and grade from in vivo prostate cancer imaging would support improved biopsy guidance, therapy selection and, possibly, focal therapy guidance. Validation of prostate cancer imaging modalities ideally requires accurate registration of in vivo imaging to histopathology, where accurate diagnoses can be made. An important intermediate component of this registration aligns ex vivo imaging to histology. This work describes and evaluates a simplified approach, developed in our laboratory, to the registration of digital prostate histopathology to ex vivo magnetic resonance (MR) images. Our approach obviates three elements typical of existing methods: (1) guidance of specimen slicing, (2) imaging/photography of sliced tissue blocks, and (3) dependence on the appearance of salient structures within the image to guide registration.

Methods:
Six resected prostate specimens were marked with strand-shaped fiducials, imaged with T1- and T2-weighted MRI before and after image-guided specimen slicing, and then processed for histology as whole mount specimens. Direct fiducial-based registration from histology to whole specimen ex vivo MRI was performed by establishing a correspondence between fiducial cross-sections on histology and fiducial space curves on whole specimen MRI. The target registration error (TRE) of 93 intrinsic landmarks across 21 histology images was calculated for this method, for an indirect registration using tissue block MRI and for a registration based on image-guidance of slicing.

Results:
The image-guided, indirect and direct registrations yielded TREs of 1.2 mm, 0.8 mm and 0.8 mm respectively. A two-tail paired t-test failed to show a significant difference between direct and indirect registration mean TREs ($p = 0.8$, 95% confidence interval, -0.08 to 0.10 mm), and showed that both TREs were lower than that of the image-guided registration ($p = 0.0001$).

Conclusions:
The direct registration is a suitable replacement for existing, more complex registration methods for aligning histopathology to ex vivo imaging.