Purpose: To measure the target registration error (TRE) of two approaches for the rigid registration of magnetic resonance (MR) prostate images to 3D transrectal ultrasound (TRUS) images, in order to improve biopsy planning and guidance for prostate cancer diagnosis. Methods: Six T2-weighted MR images and six 3D-TRUS images from six different subjects were acquired during an MRI-targeted, 3D TRUS-guided biopsy procedure. All image pairs had identifiable calcifications and/or cysts which were used as fiducials for registration validation. A total of 78 fiducials were identified and all images were segmented using a semi-automated method. The MR images were designated as the source images, and the 3D-TRUS images were designated as the target images. The source images were rigidly registered to the corresponding target images using 3 different methods. The first method was a visual alignment (VA) performed interactively by the operator, the second was a surface-based iterative-closest-point (ICP) method, and the third was least-squares best fit (LSF) transformation based on a set of identified homologous landmark pairs. We calculated the RMS TREs for each method and compared the results using a two-tailed paired t-test for each combination. Results: The RMS TREs for VA, ICP and LSF were 5.07mm, 5.87mm and 3.10mm, respectively ($p<0.05$). The difference between the VA and LSF RMS TREs was 1.97mm. Conclusions: Rigidly aligning MR images to 3D-TRUS images yielded poor results (TRE>2.5mm). This is likely due to the substantial shape distortion of the prostate, caused mainly by transducer pressure in the 3D-TRUS images, and the pressure induced by the endorectal coil in the MR images. These preliminary results indicate that, at most, an ideal rigid registration algorithm based on the operator's initialization (i.e. VA) would able to reduce the TRE by 1.97mm. The remaining error of 3.10mm would require a non-rigid registration to correct for the deformation.