# MRI of prostate patients in the radiotherapy treatment planning position

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## Introduction:

In radiotherapy planning accurate localisation and definition of the planning target volume (PTV) is of the utmost importance. This volume determines the dose received by the tumour, organs at risk and other healthy tissue. For many anatomical sites the accurate delineation of the PTV can be difficult using computed tomography (CT) alone. The excellent soft tissue contrast of magnetic resonance imaging (MRI) offers greater accuracy in defining the tumour volume. This improved confidence enables dose escalation to the tumour and dose sparing to healthy tissue. However, if the MRI scan is not acquired in the treatment position, registration with CT results in a mismatch due to the displacement of organs. This is particularly evident in prostate planning where it is not only the treatment position that is essential but bladder and rectal preparation plays a vital part. Imaging patients in the treatment position can be problematic in MRI since the table and coils are not typically designed to be either flat or compatible with immobilisation devices. It has already been shown that it is possible to image brain cancer patients in the radiotherapy position using a surface coil in MRI with similar or improved image quality to a standard head coil [1]. This concept was then extended to a flat table for MRI of prostate patients for registration with CT.

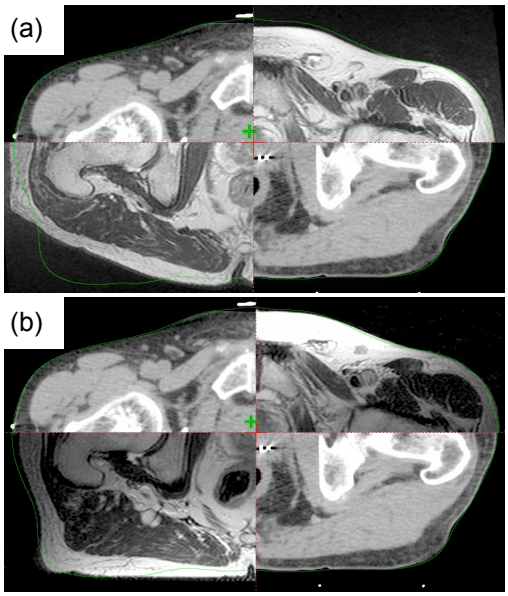


Figure 1. CT and MR registered images with MR acquired in the (a) normal position and (b) in the radiotherapy position

## Methods:

This study is an investigation of 20 prostate patients comparing the PTVs of patients in the radiotherapy position using a 4-channel cardiac coil and in the typical MRI position using a body coil. Images were acquired with a GE Signa 1.5T HDx scanner. Prostate patients received bladder preparation before being scanned in MRI and were imaged on the same day as their CT to ensure comparative positioning of the prostate. A foam insert was positioned on the curved MRI table within which the posterior section of a 4-channel cardiac coil was placed in a specially designed recess. Upon this a Perspex sheet gave a flat surface upon which to scan the prostate patients and the anterior section was situated anteriorly. When scanned in the radiotherapy position the patient's CT reference marks were aligned with a LAP laser system to ensure the scan plane matched CT. The CT datasets were registered with the MR images acquired in the normal and radiotherapy position as shown in figure 1. Registration was performed using Eclipse Version 8.6.15. MRI visible markers were positioned on the CT reference marks to give a measure of the quality of registration. All prostate patients had 3 gold markers implanted in the prostate giving an additional measure of registration.

## Results:

Preliminary results show the PTVs of patients in the radiotherapy position is different to that of patients in the MRI position. Furthermore, it was shown that patients positioned in the radiotherapy position compared to those in the typical MRI position gave a significantly improved registration with CT ($p = 0.01$). It was also found that the image quality of patients imaged with the 4-channel cardiac coil did not compromise the delineation of the PTV for the prostate patients.

## Conclusions:

By positioning prostate patients in the radiotherapy position it was found that it was possible to change the PTV. Since the imaging plane matches that of CT it can be concluded that this change is an increase in accuracy. Likewise, the improved registration determined using fiducial and internal markers offers greater confidence in the localisation of the PTV. Correct patient positioning in MR also opens up the exciting possibility of MR only radiotherapy planning.

## References:

[1] Hanvey S, Glegg M, Foster J 2009 Magnetic resonance imaging for radiotherapy planning of brain cancer patients using immobilization and surface coils *Physics in Medicine and Biology* **54** 5381- 5394.