MRI of head and neck patients in the radiotherapy treatment 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 difference in imaging planes. This is particularly evident in head and neck planning, where acquiring the MR datasets in the treatment position helps to improve registration with CT. 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 oropharynx patients for registration with CT.

Figure 1. 4-channel cardiac coil positioned laterally around a thermoplastic face mask secured on a flat table

Methods:

This study is an investigation of 20 head and neck patients comparing the PTVs in the radiotherapy position with a 4-channel cardiac coil and in the typical MRI position using a neurovascular coil. Images were acquired with a GE Signa 1.5T HDx scanner and a GE flat table with indexes to position an immobilisation base-plate was used to secure oropharynx patients within an immobilisation device. A 4-channel cardiac coil was positioned laterally centred over the treatment site as shown in figure 1. When scanned in the radiotherapy position the prostate patient's CT reference marks were aligned with a LAP laser system to ensure the scan plane matched CT. The CT and MR datasets were registered 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.

Results:

Preliminary results show the PTV 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 an improved registration with CT. 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 head and neck patients.

Conclusions:

By positioning head and neck 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 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.