MRI of Head and Neck Cancer Patients for Radiotherapy Treatment Planning

S. Hanvey[1], M. Glegg[2], and J. Foster[3]
[1]Department of Clinical Physics and Bioengineering, Beatson West of Scotland Cancer Centre, Glasgow, Lanarkshire, United Kingdom, [2]Beatson West of Scotland Cancer Centre, [3]Glasgow Cardiac Magnetic Resonance Unit

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, particularly in patients with metallic dental work. 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. This is particularly evident in head and neck planning because of the difference in imaging planes and neck flexion. 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 extended to a flat table for MRI of oropharynx patients for registration with CT. The purpose of this study was to determine whether it is necessary to immobilise patients for their MR radiotherapy planning scan or if a normal diagnostic MRI would suffice.

Figure 1. Surface coil positioned laterally around a thermoplastic face mask secured on a flat table

Methods:

This is an ethically approved investigation of 20 head and neck patients comparing scans in the radiotherapy position using a surface coil with scans 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. The surface coil was positioned laterally centred over the treatment site as shown in figure 1. 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. This scan was then repeated without immobilisation in a neurovascular coil. The CT and MR datasets were registered using the treatment planning software Eclipse, version 8.6.15. Rigid structures were outlined in the CT and MRI datasets to give a measure of the quality of registration. The size of the PTV was also investigated comparing CT alone with the CT-MR registered datasets.

Results:

It was found that the image quality of patients imaged with the surface coil did not compromise the delineation of the PTV or organs at risk for head and neck patients. The results show that the PTV of patients using CT alone is significantly larger than that of MRI-CT registered images. Furthermore, a marked improvement in the quality of registration was shown when patients were immobilised over the typical MRI scan.

Conclusions:

By registering the CT to MRI datasets a significant change in the PTV was found, showing the necessity for the inclusion of MRI in the radiotherapy planning of head and neck patients. There is also an improvement in the quality of registration when patients are immobilised for a radiotherapy planning MRI scan. This improved accuracy 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.