Purpose:

A sensitivity analysis of the effect of variations in electron density data (ED) on dose calculation accuracy for MRI based cervical cancer treatment planning.

Methods:

Five cervical cancer patients were analysed in this work. Planning CT scans represented gold standard ED data. Standard four field 3DCRT plans (prescription 45Gy) were designed on these CT scans. The CT data was then manipulated to simulate the following methods of assigning ED to MRI; (1) homogenous bulk density corrections, (2) Bulk density correction to bones, (3) rigid image registration of CT to MR, and (4) regression analysis based pseudo CT. Plans were then generated on the manipulated data sets, and compared to the plans generated on the original. Dose was analysed using Chi analysis and equivalent uniform dose (EUD). Data was analysed to quantify (A) the effect on plan design (called optimisation error), and (B) the effect on dose calculation accuracy (systematic error).

Results:

Analysis of the averaged patient results showed that for 3DCRT, the use of imperfect electron density data had minimal impact on plan design for all tested data sets. Analysis of systematic error showed minimal errors for cases (1), (2) and (3), where average errors of less than 0.3 Gy in EUD were recorded and Chi analysis showed that over 95% of points within the high dose region (D>36Gy) were within 2% or 2mm of the original dose. For case (4), errors greater than .5 Gy in EUD were recorded; these were not considered acceptable errors.

Conclusions:

Using imperfect electron density data for 3DCRT treatment planning for cervical cancer patients is feasible for appropriately considered choices of electron density assignment. Further analysis is needed to test this result for IMRT, and is ongoing.