A novel prospective decision support method to estimate the value of a rectum spacer: ‘Virtual Rectum Spacer’.

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Objective

- Intensity-modulated radiation therapy (IMRT) for prostate cancer causes potential acute and late rectal injury.
- An implantable rectum spacer (IRS) is an application of an absorbable hydrogel, inserted between the prostate and the rectum, which consequently increases the distance between these organs (Fig. 1).
- Previous studies have confirmed that an IRS decreases acute rectal toxicity.
- Implantation of a IRS is relatively expensive and invasive.

Goal → To identify a decision support system beforehand whether a specific patient will benefit from a IRS whether it will be cost efficient.

A novel method to predict on CT images with a ‘virtual’ IRS through non-rigid deformations based on a CT scan without IRS to be integrated into a decision support system.

Materials & Methods

- In 16 patients with localized prostate cancer a hydrogel spacer (SpaceOAR®, Augmenix) was injected.
- CT-scans with and without IRS were acquired.
- A training set was developed based on IRS contours of the first 8 patients.
- The overlapping volumes of IRS of different patients having a probability of >3 contour corresponded with a volume of 10 cc and was used the IRS model.
- From this model, a deformation field was calculated that mimics the expansion of the IRS between the prostate and the rectum.
- The CT images of the remaining 8 patients were used to validate the virtual IRS model. For this the distance between the rectum and the prostate was compared for the virtual IRS and the actual IRS.

Figure 1: Axial T2 magnetic resonance images of a patient with a IRS before injection and after injection.

Figure 2: For one patient, the CT with and without IRS, and with the virtual IRS are shown. The contours on the right show the overlap of the real and the virtual contours.

Results

- An example of the virtual IRS is shown in figure 2 where the contours of the real IRS and virtual IRS show a good overlap (DICE = 0.63).
- The average minimum distances between the prostate and rectum of all 8 patients in the validation set increased with 3.7±2.4 (1SD) mm when the virtual RS was applied.
- For the real RS the average increase in minimum distance was 5.4±2.7 mm.
- The mean distances between the prostate and rectum without RS was 15.8±3.2 mm, with the virtual RS this was 19.5±3.3 mm comparable to the real RS 22.0±4.3 mm.

Conclusions

- We have developed a novel method to simulate a model based virtual RS to identify patients with a potentially high benefit of a RS implantation.