

MSc. Research Project: Uterus and cervix motion during radiotherapy for cervix cancer

Gillian Bestwick MSc., BSc. FOCUS Research Radiographer gillian.bestwick@nhs.net

Background

Radiotherapy is commonly used to treat cervix cancer. Over the course of treatment the target organs which are the cervix and uterus can move due to changes in bladder volume. A margin is added around these organs to account for this movement.

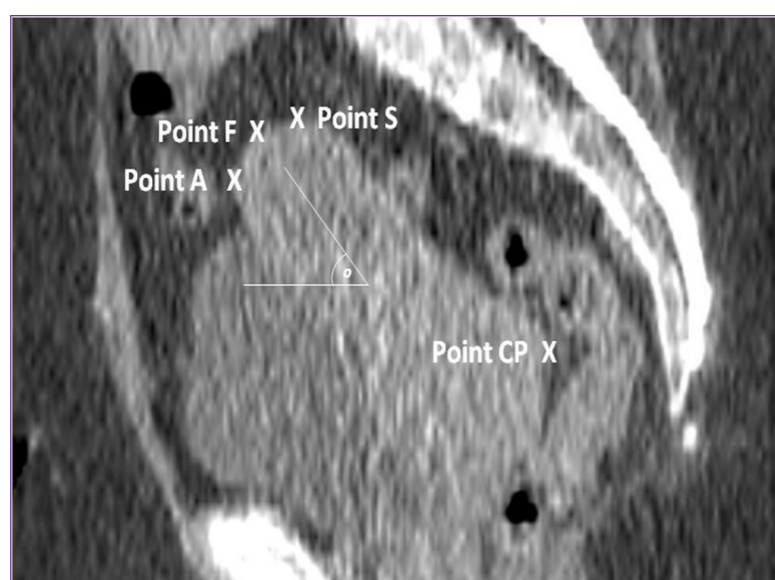
Knowledge of how much they move can help in decisions of margin size. The smaller the margin needed, the less normal healthy tissue will be irradiated leading to fewer side effects.

This project investigated the movement of the cervix and uterus in patients with cervical cancer undergoing radiotherapy treatment and assessed the relationship between uterus and cervix positional change and bladder volume.

Method

85 retrospective radiotherapy treatment images from 11 patients with cervix cancer were fused with the radiotherapy planning CT scans. Patients had been given instructions to finish drinking four cups of water (approximately 800 ml) 40 mins prior to their planning CT scan and radiotherapy treatment appointment times.

The change in the uterus and cervix positions on the radiotherapy treatment scans compared to the planning CT scans was quantified by measuring the distance between points of interest (POI) on the tip of the uterine fundus (Point F), the most anterior and superior aspects of the uterus (Point A and Point S) and the most posterior aspect of the cervix (Point CP). The change in uterine angle and bladder volume was also measured.



Point of interest placement and uterine body angle on a radiotherapy planning CT scan

The bladder was outlined on each axial slice of the planning CT and radiotherapy treatment scans and the volume then computed. The change in bladder volume between the planning scan and radiotherapy scans was then calculated.

Changes in the POI position and uterine angle were correlated with bladder volume changes using a statistical method of linear regression.

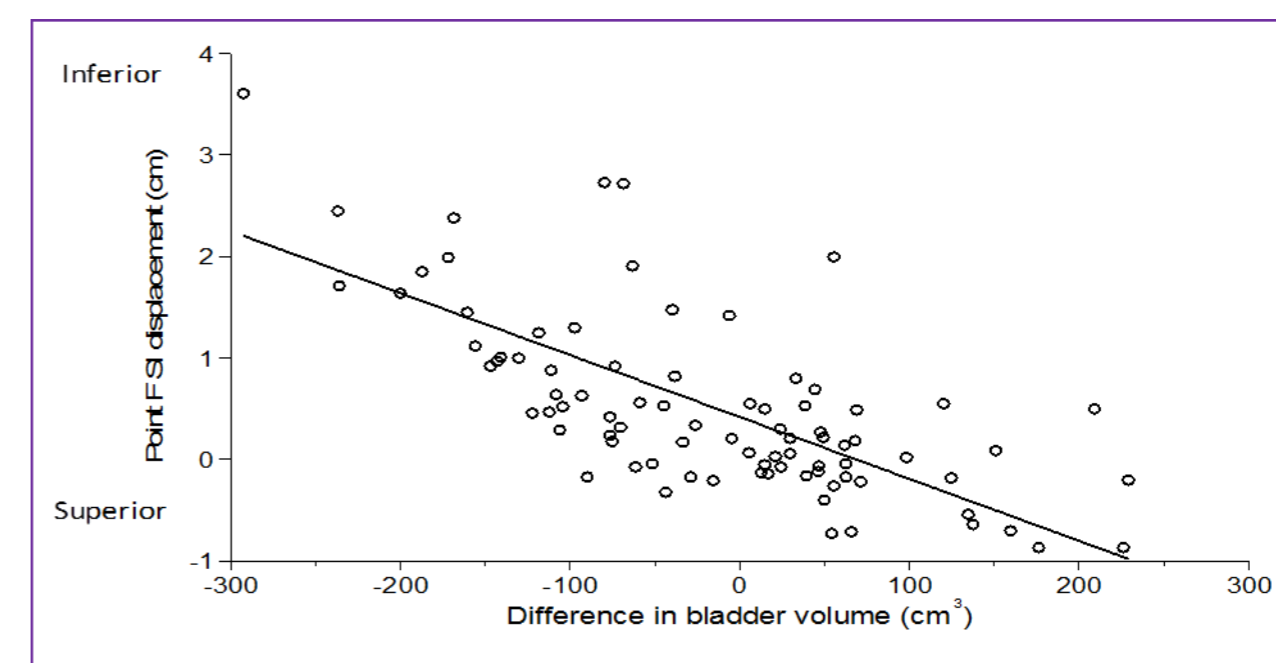
Results

Movement of the uterus and cervix

The displacement ranges of the uterus and cervix were large and varied widely from patient to patient. The mean value of the displacement of all points for the patients combined was within 1 cm, however 4 of the 11 patients had means of 1-1.45 cm. Two patients had uterine fundus movement ranges greater than 4cm.

Correlation between bladder volume and inter-fractional variation of uterus and cervix position

For all patients combined there was a significant correlation relating the change in bladder volume to the movement of the uterus and cervix with regards to all the measured points and the change in uterus angle. There was greater correlation with the change in uterus position and change in bladder volume compared to the cervix.



Correlation of the displacement of Point F (uterine fundus) in the superior-inferior direction in relation to bladder volume change for all patients

Variation in bladder volumes

Despite all patients in this study having been informed to follow a bladder full drinking protocol, there was a large inconsistency / variability of bladder volumes measured on the CBCT scans.

Conclusion

Uterus and cervix movement throughout a course of radiotherapy can be substantial and can vary from patient to patient. Despite the use of a full bladder drinking protocol large variations in bladder volumes between treatments can occur. This can impact on the position of the uterus and cervix. The larger the bladder volume change the larger the uterus and cervix movement from radiotherapy planning position to radiotherapy treatment position was observed. Ensuring patient compliance of the full bladder drinking protocol and daily ultrasound imaging before each fraction of radiotherapy is suggested to minimise changes in bladder volume and therefore reduce uterus and cervix movement.

References

1. Ahmad R, Hoogeman MS, BondarM, et al. Increasing treatment accuracy for cervical cancer patients using correlations between bladder-filling change and cervix and uterus displacements: proof of principle. Radiother Oncol 2011;98(3):340-346.
2. Huh SJ, Park W, Han Y. Interfractional variation in position of the uterus during radical radiotherapy for cervical cancer. Radiother Oncol 2004;71(1):73-79.
3. Taylor A, Powell MEB. An assessment of interfractional uterine and cervical motion: implications for radiotherapy target volume definition in gynaecological cancer. Radiother Oncol 2008;88(2):250-257.