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Prehabilitation to Improve Positioning Reproducibility in Patients Undergoing Pelvic Radiation Therapy

Alexander Lukez
University of Massachusetts Medical School

Et al.

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Alexander Lukez, BS, Lauren O'Loughlin, BS, Yunsheng Ma, MD, PhD, MPH, Jennifer Baima, MD, & Janaki Moni, MD
University of Massachusetts Medical School, Worcester, MA

PURPOSE / OBJECTIVE

Reproducible patient positioning is essential for precision in radiation therapy (RT) delivery. However, a retrospective review of pre-treatment imaging demonstrated variability in daily patient set-up.

We tested the hypothesis that a structured daily pre-treatment stretching regimen is both feasible and effective for minimizing variability in positioning, as measured by sacral slope angles (SSA).

MATERIAL & METHODS

Eight female patients undergoing pelvic radiotherapy performed a structured daily hip exercise regimen (extension and external rotation) immediately prior to simulation and daily treatment. The control group of 20 patients (17 female and 3 male) had usual care. SSA measurements on daily pre-treatment imaging were compared to SSA measurements from the simulation CT for 5 weeks.

The extent of SSA variability between two groups and over time was analyzed using a linear mixed model. The same two readers independently measured SSA, comparing SSA on the day of simulation to SSA measured on each day of RT. Subjects enrolled in the study completed between 23 and 29 radiation treatment fractions (mean = 25.88, median = 25).

RESULTS

Figure 1: Retrospective subject DRR with SSA measurement (40.4°) compared to daily port film with SSA measurement (45.0°).

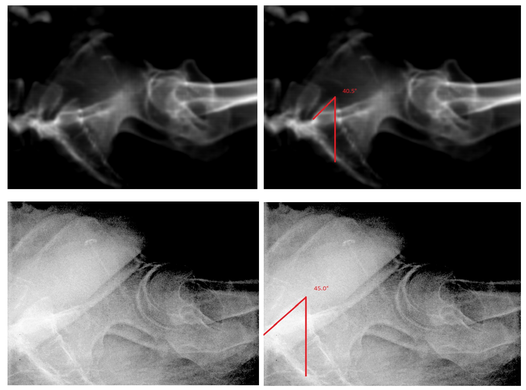


Figure 2: Prospective subject DRR with SSA measurement (51.6°) compared to daily port film with SSA measurement (51.5°).

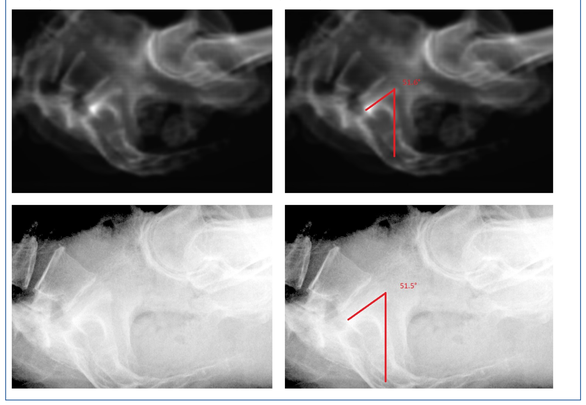
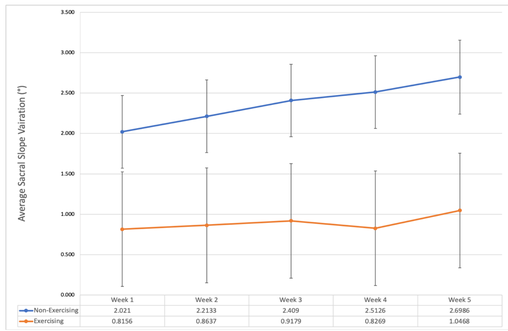
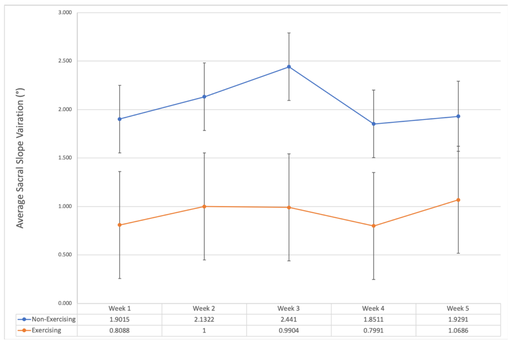


Figure 3: Average SSA variation across treatment weeks using cumulative patient data set (x-axis: treatment week, y-axis: degree of variability). Summative weekly data for baseline CT Sim SSA to SSA from each day of treatment.



	Week 1	Week 2	Week 3	Week 4	Week 5
Non-Exercising	2.021	2.2133	2.409	2.5126	2.6986
Exercising	0.8156	0.8637	0.9179	0.8269	1.0468

Figure 4: Average SSA variation across treatment weeks using cumulative patient data set (x-axis: treatment week, y-axis: degree of variability). Figure represents summative weekly data for day-today SSA variation.



	Week 1	Week 2	Week 3	Week 4	Week 5
Non-Exercising	1.9015	2.1322	2.441	1.8511	1.9291
Exercising	0.8088	1	0.9904	0.7991	1.0686

Average variation in daily SSA from baseline SCT among the intervention subjects was 0.91° (±0.58°), ranging 0.57° - 1.27°. In the non-exercising cohort, the average variation for the control subjects was 2.27° (±1.43°), ranging among subjects from 1.22° - 5.09°. Comparing weekly SSA variation for each prospective subject to the average weekly SSA variation in the non-exercising cohort; the overall difference between the two cohorts was statistically significant (p=0.0001). SSA measurements were also compared between treatment days, looking at variation from one day to the next. The absolute difference was calculated between treatment days and average variation for all eight subjects was 0.95° (±0.72°). The average variation across subjects ranged from 0.73° - 1.26°. In the retrospective non-exercising cohort, the average variation across all 20 subjects was 2.05° (± 1.47°), ranging from 0.97° - 3.21°. The overall difference between the two groups was statistically significant (p<0.0001). Feedback was requested six to twenty months post-treatment. No subjects reported any adverse effects of radiation. Five out of the seven subjects contacted continued to perform the exercises in some capacity after study completion. Overall, subjects rated the helpfulness of the exercises as an average 6.6/10.

SUMMARY / CONCLUSION

We demonstrated a significant decrease in the variability of SSA by implementing a simple pre-treatment stretching program, whereas control subjects exhibited an increasing variability of SSA over the course of treatment. We conclude that there is a potential benefit for prehabilitation during pelvic RT.

A challenge provided by this research was accurate measurement of SSA variation. There is subjectivity in human reader measurement. Incorporating anterior-posterior (AP) film coordinates may capture set-up variability and improve measurement reliability. We draw this suggestion from a breast cancer set-up variability study that evaluated translational error in three dimensions; left-right, AP, and cranial-caudal planes.

Future studies would benefit from randomized clinical trial design with larger sample sizes and longer follow-up duration. Reduction of toxicity may not be evident without a reduction in margins around the target based on the improved reproducibility of patient positioning.

REFERENCES / ACKNOWLEDGEMENTS

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