Institutional performance on IROC phantom as a function of phantom type: a multi-variate analysis

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INTRODUCTION

- IROC Houston distributes anthropomorphic phantoms worldwide, for clinical trial credentialing.[1]
- A multivariate analysis will allow us to distinguish possible trends in any given phantom which may be leading to increases in dose deviations or failures.

AIM

To compare differences in institution irradiation accuracy between different Imaging and Radiation Oncology Core (IROC) phantoms, and across multiple irradiations of the same phantom

METHOD

1(a) Compared the dose deviations (treatment planning system (TPS) vs. measured) from institutions who each irradiated the IROC **spine**, **head & neck** (H&N) and **lung** phantoms at different points in time.
(b) Performed one-way ANOVA with repeated measures and pairwise regression analyses on the phantom groups to assess their differences in dose deviation.
2 Phantom irradiations repeated (not to remedy a failed result) by an institution 3 or more times on any given phantom were separately examined to assess whether increased familiarity with the phantom and process improved results.

RESULTS

Results from 60 institutions who each irradiated all 3 phantoms: spine, H&N and lung were assessed, only 5 of which were failing results. The average dose deviation of the three groups were all within 1% of each other (spine: 2.42%, H&N: 2.23%, lung: 3.02%) and the H&N and lung results were found to be significantly different ($p < 0.05$). No direct correlation was found between any pair of phantom results ($R^2 < 0.15$), suggesting that performance in one was not a predictor of performance in another (Fig.1). Assessment of repeated phantom irradiations showed no consistent improvement of results over time (Fig.3).

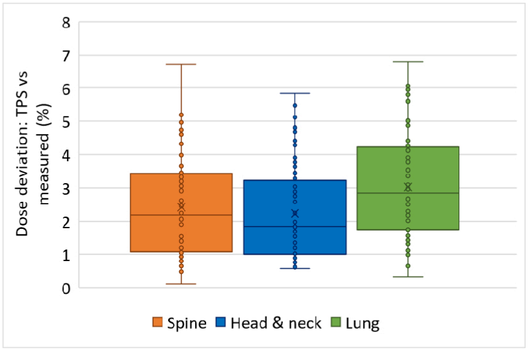

Fig. 1. Box and whisker plots showing the similarities in the average dose deviation among the three phantom groups.

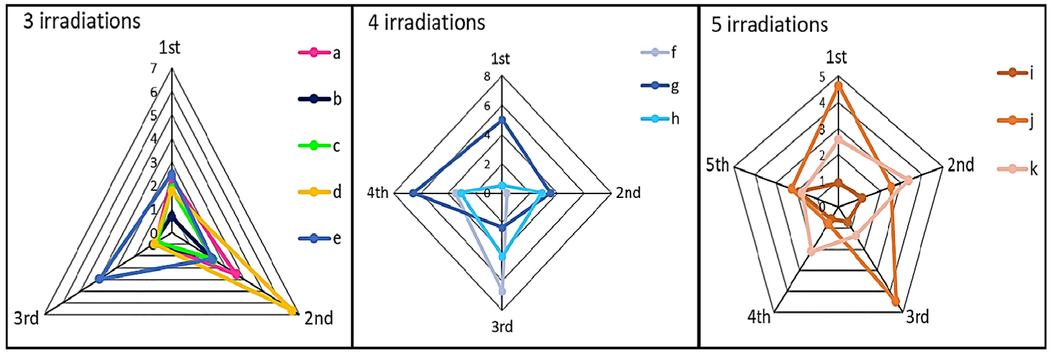

Fig. 2. Radar plots showing the distribution of dose deviations for institutions who irradiated any given phantom 3 or more times (none of these instances was a repeat to rectify a failing irradiation). Each letter represents a separate institution-phantom combination and institutions with 3, 4 and 5 subsequent irradiations are grouped together. Smaller dose deviations are shown by smaller circumferences on the radar plot whereas data points showing larger deviations fall near the outer perimeters. There was no overall decrease in dose deviations with increasing number of irradiations, indicating that familiarity with the phantoms did not improve success overtime.

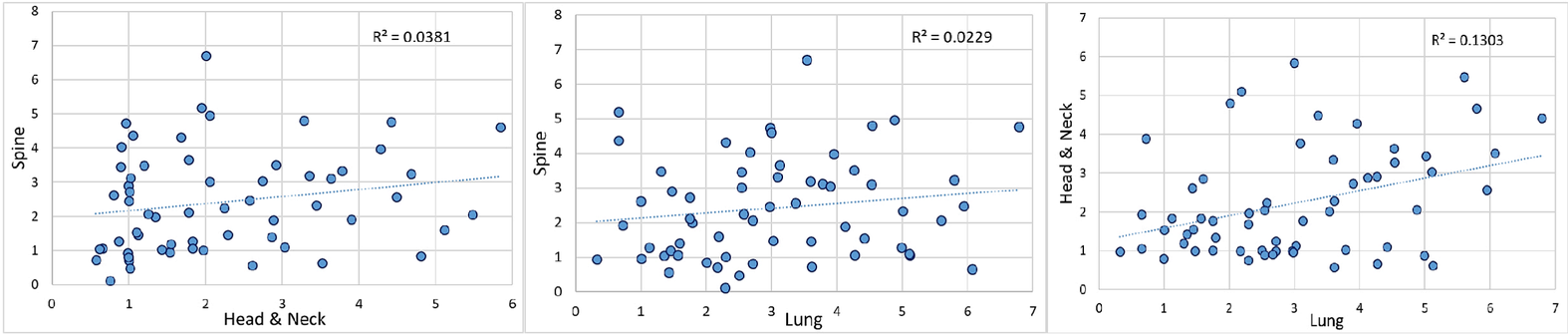

Fig. 3. Regression plots showing very little correlation in dose deviation between pairs of phantom results. This indicates that an institution's performance in one phantom irradiation does not predict their performance on another type of phantom irradiation.

CONCLUSIONS

1.
a) Institutions performed similarly on average among the 3 phantoms

b) Irradiation performance is not largely influenced by phantom type, but by the institution's radiation therapy (RT) process.

c) The absence of direct correlations between phantoms validates their capability to test distinct aspects of the RT process

2. Assessment of multiple irradiations did not show improvements in accuracy over time, which demonstrates that the RT process, not phantom familiarity, is driving performance, as is desired for an audit.

ACKNOWLEDGEMENTS

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