Purpose:

To develop a predictive model to assess the quality of critical organ dose sparing in IMRT plans by providing patient specific dose sparing references, based on an array of patient anatomical features and prior planning experience.

Methods:

Contributions of various patient anatomical features to the inter-patient OAR dose sparing variation in IMRT planning were systematically studied using machine learning method based on high quality prior plans. The dependence of anatomical factor on OAR dosimetric parameters is formulated into predictive models. The OAR dosimetric parameters generated by these predictive models represent the "best feasible" clinical outcomes based on past planning experiences.

IMRT plans of 88 prostate, 106 head-and-neck (HN) and 21 spine SBRT treatments were used to train the models. The final models were tested by additional 24 prostate and 48 HN plans. The model for spine SBRT was tested by the leave-one-out method.

Results:

For HN and prostate planning, the significant patient anatomical features that affect OAR sparing are: the distance between OAR and PTV, the portion of OAR volume within an OAR specific distance range, the overlap volume between OAR and PTV, and the portion of OAR volume outside the primary treatment field.

For spine SBRT planning, the most significant patient anatomical feature that affects cord sparing is the tightness of the geometric enclosure of PTV surrounding the cord and the homogeneity of PTV dose coverage.
The dosimetric parameters predicted for the test patient cases using the models were in agreement with those from the clinical plans in more than 75% of the cases.

Conclusions:

The developed predictive models indicated substantial correlation between some important patient anatomical features and OAR dose sparing based on expert experiences. These models can be used as effective tools for evaluating the quality of treatment plans customized to individual patient’s anatomy.

Funding Support, Disclosures, and Conflict of Interest:

Partially supported by a master research agreement with Varian Medical System, Inc.