Purpose:

For IMRT treatment planning, an index-dose based algorithm features a fast approach in optimizing beam shapes and weights, and the quasi-Newton method is adopted in segment weight optimization by many commercial products. By combining these two optimizers, we aim to improve IMRT plan quality by achieving better normal tissue sparing.

Methods:

An IMRT plan was generated using an in-house treatment planning system in three steps: 1) optimize fluence using beamlet intensity modulation, 2) generate Multi-collimator leaf sequence and segment weights, 3) tune the segment shapes and weights as each segment treated as a single beam. A quick converge was achieved by the optimizer implementing the index-dose concept in step (1 and 3). To further improve the plan's quality, we optimized the segment weights via a quasi-Newton gradient search method where a convex objective function was constructed using both existing segment shapes and dose constraints defined by the planner. Thus, the segment shapes were optimized with index-dose, the shapes optimized with quasi-Newton, alternately. The new approach was evaluated with patient cases including prostate and head & neck.

Results:

Both plans had equivalent tumor dose coverage. For the prostate case, the rectal dose was reduced by 6% for V60% and 2% for V10cc, respectively. For the head and neck, better sparing was observed for the spinal cord, the left parotid, and the larynx.

Conclusions:

Combining index-dose and quasi-newton gradient search can effectively improve sparing of normal tissues without sacrificing target dose coverage. This work indicates the potential of improving treatment plan quality by integrating different optimization methods.