Purpose: Recently, a new IMRT optimization containing a total-variation (TV) with quadratic programming was proposed, which simplifies fluence-map by generating piece-wise constant solution. In practice, however, the traditional quadratic programming takes large memory space and the convergence rate is not ideal. As thus, determination of weighting factors of different structures remained to be trial-and-error in nature due to time limitation. This study proposes a new efficient method of appropriately determining weighting factors of critical structures using the profits given by a new L1-solver, Template for First-Order Conic Solver (TFOCS).

Methods: The flexibility in defining the constraints in optimization with guaranteed convergence rate by TFOCS solver allows for modifying the process of determining weighting factors and optimizing beamlet-intensity map. To specify the relationship of weighting factors of structures, an optimizing process with only PTV is performed. Based on the residues of structures, prescribed residues on PTV and OAR, and the size of matrices, weighting factors are finally determined. With determined parameters, PTV and OAR, a fluence-map optimization is executed by TFOCS. To validate this method, head-neck patient data was used.

Results: The proposed method shows the efficiency in IMRT optimization by offering the proper weighting factors. With the new optimizing process, dose deliverability and quality of dose distribution are well balanced by properly defining the residues on PTV and OAR. With relatively large prescribed residue on OAR, it only demands 35 segments for 7 beams configuration for treatment. Contrarily, small prescribed residue adds the complexity in fluence-map, requiring 50 segments with better dose conformality.

Conclusions: The proposed method offers the effective way of determining weighting factors of different structures with guaranteed convergence rate and flexible constraint setting through a new L1-solver TFOCS.