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Deep Learning-Based Auto-Contouring for Nasopharyngeal Carcinoma: Consistency Evaluation and Performance Optimization

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Published 03/05/2025

Yuhao Lin [1], Linghui Yan [1], Zhaodong Fei [1], Chuanben Chen [1]

1. Radiation Oncology, Fujian Cancer Hospital, Fuzhou, CHN

Corresponding author: Yuhao Lin, dcl0930@126.com

Categories: Medical Physics, Radiation Oncology
Keywords: auto-contouring, nasopharyngeal carcinoma, performance optimization

How to cite this abstract
Lin Y, Yan L, Fei Z, et al. (March 05, 2025) Deep Learning-Based Auto-Contouring for Nasopharyngeal Carcinoma: Consistency Evaluation and Performance Optimization. Cureus 17(3): a1400

Abstract

Objectives:

Contour delineation is crucial for ensuring the efficacy and side effects of radiotherapy (RT), but it inevitably involves inter-observer variability (IOV). Deep learning (DL) models have been used to assist in contour delineation, but further evaluation is needed to guide healthcare professionals in the judicious application of DL models.

Methods:

The contours of 22 anatomical structures and the gross tumor volume (GTV) for 30 patients with nasopharyngeal carcinoma were delineated using four DL models: AccuContour, RT-Viewer-contour, RT-Mind, and PVmed Contouring, The overall kappa values and generalized conformity indexs of these contours were calculated to assess consistency. The Dice Similarity Coefficient (DSC), Relative Volume Difference (RVD), 95th percentile Hausdorff Distance (HD95), and Average Symmetric Surface Distance (ASSD) were calculated to evaluate the accuracy of the contours. Additionally, we introduced two innovative model frameworks to improve the fidelity and reliability of patient contour delineation.

Results:

The consistency of the contours generated by the four DL models was poor for GTV, pituitary gland, temporal lobes, and temporomandibular joints. Significant differences were still observed between the contours generated by the models and the manual delineations by oncologists for the GTV, lens, optic nerves, pituitary glands temporomandibular joints, temporal lobes, and trachea. The model frameworks we proposed can effectively optimize the contours of GTV, brainstem, eyes, lens, and temporomandibular joints.

Conclusion(s):

The contours generated by DL models still have deficiencies in the application of nasopharyngeal carcinoma radiotherapy. We proposed two model frameworks which increasing the stability and accuracy of automatic contouring and saving physicians' time for review and modification.