AI for automated contouring of primary tumor volumes for nasopharyngeal carcinoma

In collaboration with computer scientists from the Chinese University of Hong Kong, the research team led by Prof. Sun Ying (孙颖) at Sun Yat-sen University Cancer Center has achieved automated contouring of primary tumor volumes for radiotherapy of nasopharyngeal carcinoma (NPC) using artificial intelligence (AI) technique, which was published in *Radiology* (https://doi.org/10.1148/radiol.2019182012).

NPC may be cured by radiotherapy. Tumor proximity to critical structures demands accuracy in tumor delineation to avoid toxicities from radiotherapy. However, tumor target contouring for NPC radiotherapy is labor intensive and highly variable among radiation oncologists. To improve contouring accuracy and efficiency, Sun's group constructed and validated an AI contouring tool to automate primary gross tumor volume (GTV) contouring in NPC by training a three-dimensional convolutional neural network (3D CNN) in 4,084 magnetic resonance imaging (MRI) examinations of 1021 patients.

In 203 testing patients, they found a strong concordance between the AI tool and human experts for GTV contouring, with an overall accuracy of 79%, regardless of tumor stage (early or advanced stage) and chemotherapy status (pre- or post-chemotherapy). Remarkably, when assessed by the human experts, the AI-automated contours of 66 (32.5%) patients were considered as no revision needed, implying direct use of the AI-automated contours for radiotherapy treatment planning without any correction; and only minor corrections (<20%) were needed for the AI-automated contours of other 114 (56.2%) patients. It is noteworthy that the AI tool achieved higher inferior accuracy at the cranial-caudal edges (accuracy of 75%) than those at the midsections (accuracy of 82%—83%) of the tumor. Going forward, they aim to circumvent this deficiency by accumulating larger datasets that would include tumors with more intracranial and hypopharyngeal extensions.

More excitingly, in a multicenter test involving 20 patients and eight radiation oncologists from seven hospitals, the AI tool outperformed four of eight radiation oncologists and was non-inferior to the other four. To explore the potential clinical benefits of the AI tool, two months after the test, the eight radiation oncologists were asked to correct the AI-automated contours, which is a process called AI-assisted contouring. With AI assistance, they observed substantial improvements of contouring accuracy in 5 of 8 radiation oncologists, as well as significant reduction of inter-observer variation (by 54.5%) and contouring time (by 39.4%). The improvement of contouring accuracy could potentially have a positive impact on tumor control and patient survival. For further study, they are now planning a prospective, multicenter trial to address more concrete real-world clinical benefits of AI-assistance for tumor target and organs at risk (OARs) contouring in NPC patients.

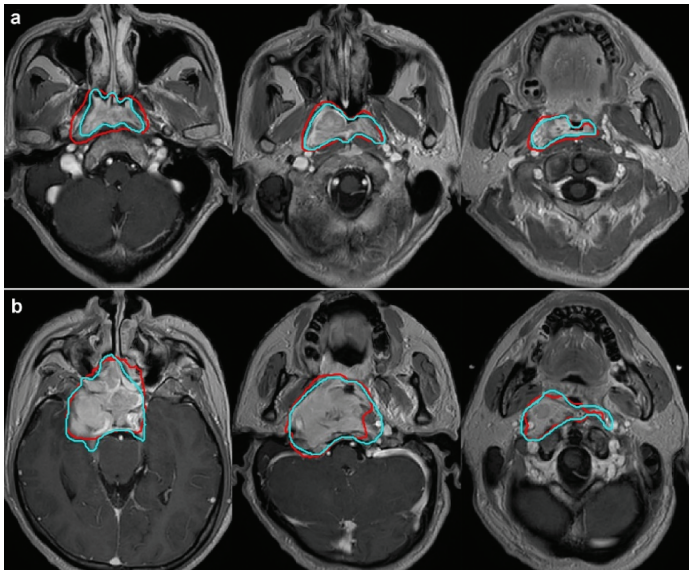

Figure Examples illustrating the level of concordance for primary gross tumor volume contours between the AI tool and human experts through superior, median and inferior sections within the tumor on T1-w MRI sequence of two patients.