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Clinical Evaluation of An Auto-Segmentation Tool for Spine SBRT Patients

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Abstract
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Abstract

Objective: Spine SBRT target delineation is time-consuming due to the complex bone structure. Recently, Elements SmartBrush was developed by Brainlab to automatically generate a clinical target volume (CTV) based on a manually drawn gross tumor volume (GTV) object. The aim of this project is to evaluate accuracy and efficiency of SmartBrush auto-segmentation tool.

Methods: 19 spine SBRT patients with 20 sites (T spine or L spine) treated at our institution were used for this retrospective comparison study. Simulation CT images and physician-drawn GTVs were inputs for the SmartBrush. The SmartBrush can segment the vertebral body (VB), generate a CTV based on the GTV, and split the vertebral body into 6 different parts according to the International Spine Radiosurgery Consortium (ISRC) Consensus guidelines (and subsequently generate a CTV). The SmartBrush generated contours can be edited by including/ excluding different parts of vertebral bodys if necessary. The SmartBrush generated contour was compared to the clinically-used CT using qualitative and quantitative methods. The contours were compared using visual assessment by the clinician, relative volume differences, and dice similarity coefficients.

Results: Qualitatively the study showed that Smartbrush can segment VB more accurately and consistently than humans at normal curvature conditions. Human errors of mistakenly identified spine columns and its parts can be reduced greatly if the auto-segmentation is used as the first step. Conversely, SmartBrush may mistakenly split or join different spine columns when large curvatures in anatomy exist (for example at the L spine and sacrum junction). In this study, human interactions were needed in 7 of 20 cases to modify the SmartBrush generated contour. In 90% of cases, the volume difference is within ±15%. The average of relative volume difference and dice similarity coefficient for 20 cases were 4%± 12% and 0.86±0.06, respectively.

Conclusion: Smartbrush can auto-segment the vertebral body quickly and accurately and has good agreement with clinically-generated contours. Inter-person deviation can be reduced with Smartbush. But physician editing is needed for some occasions. Our study supports the idea of using SmartBrush as the first step for spine SBRT target delineation to improve the contouring consistency as well as reduce contouring time.