Multiple Imaging Modalities for Evaluation Stereotactic Radiosurgery for Brain Metastatic Lesion

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Objectives: Neuro function and structure of Cerebellum are still lack of enough knowledge to be described due to limitation of different resources such as imaging modalities availability, direct clinical data, and qualified researchers. Most of current studies was utilized Magnetic Resonance Imaging (MRI) and diagnostic computer tomography with contrast agents. Modern Linear accelerator X-ray for stereotactic radiosurgery usually equipped with onboard Cone Beam Computed Tomography (CBCT) imaging system, which is used for target localization before dose. In this study, the sensitivity of on-board CBCT imaging was evaluated through comparing with MRI and CT images for brain metastatic stereotactic radiosurgery (SRS) with volumetric perturbation methodology.

Methods and Materials: A brain Metastatic SRS case was selected for this study. During the patient care procedure, several imaging modalities was utilized. These imaging modalities include MR, CT and CBCT. And these images were taken by Siemens MR Scanner, GE LightSpeed RT System, and On-board-imager (OBI) on Truebeam Linear accelerator from Varian Medical System. The volumetric perturbations were generated by the percentage of prescription dose for the treatment. The percentages range from 120%, 100%, 80%, 60%, 40% and 20%. The collected images information include volume, minimum Hounsfield Unit (HU), maximum HU, mean HU, standard deviation of HU in selected volumes. The second order standard deviation method was applied to compare the sensitivity of among these imaging modalities for these volumes of interest.

Results: In this study, based on the selection volumes , which were 24.37cc, 34.01cc, 45.72cc, 67.79cc, 132.19cc and 383.73cc, the corresponding differences of second order standard deviation in HU for CT to MR were 119.01, 91.67, -34.42, -133.08, -237.01, and -256.05; for CBCT to CT were-17.22, -40.38, -54.24, -75.72, -98.51, and -92.90; for CBCT to MR were 101.797, 51.29, -88.664, -208,795, -335. 518, and -348.95.

Conclusion: Modern Linac system for SRS provided OBI for CBCT imaging for evaluation of brain metastatic patient under SRS procedure. And the procedure could embed an instantly post treatment CBCT imaging for tumor response evaluation. Further development could apply selecting spectrum of imaging system for precise analysis of microscopic structure of brain metastatic tumor.