

Correlation between External and Internal Markers for Abdominal Tumors: Implications for Respiratory Gating

D.P. Gierga, G. Sharp, J. Brewer, M. Betke, C.G. Willett, G.T.Y. Chen

Department of Radiation Oncology, Massachusetts General Hospital, Boston, MA

Department of Computer Science, Boston University, Boston, MA

Purpose/Objective

Respiratory gating is currently being used as one method to mitigate the effects of respiration-induced tumor motion during treatment. Gating systems rely on the assumption that the motion of an external skin marker is representative of the motion of the actual tumor. Other studies have examined the correlation between external markers and the diaphragm. This study examines the relationship between external skin markers and abdominal tumors using fluoroscopic imaging and computer vision tracking techniques.

Materials/Methods

Patients with abdominal tumors and surgically implanted metallic clips were observed under fluoroscopy. Clips were implanted at the gross tumor periphery under CT guidance. Radio-opaque markers were placed on the patient's skin at midline from the xyphoid process to the umbilicus. Motion of the internal clips and the surface markers were simultaneously recorded by videotaping the fluoro image from the lateral view. Computer vision techniques, using a normalized correlation coefficient algorithm and estimates of the clip velocity, were used to track the movement of the internal and external markers. Motion data were analyzed to examine the correlation between the two sets of markers.

Results

Preliminary results indicate that internal tumor motion is well correlated with external marker motion for abdominal tumors. The periodicity of external and internal motion is similar, each with a period of about 3 seconds. For one patient, the peak-to-peak internal clip motion in the cranio-caudal direction was 14 mm, while the external marker motion ranged from 10–15 mm peak-to-peak, depending on where the external marker was placed relative to the tumor. Internal clip motion in the anterior-posterior direction was also significant, with peak-to-peak motion of 10 mm. Serial motion studies will also be presented, in which the daily variations in the correlation of internal and external marker motion were investigated.

Conclusions

Fluoroscopy and image processing techniques were used to investigate the correlation between internal and external markers for respiratory gating. Initial results indicate that internal and external marker motion are generally consistent, although the magnitude of external marker motion does vary depending on marker placement. Respiratory gating relying on the motion of external markers can be applied to abdominal tumor sites.

Respiratory Motion of internal clips and external skin markers

