PACS-Integrated Lesion Tracking Tool Enables Efficient Lesion Measurement and Reveals High Proportion of Metastatic Lesions Showing Mixed Response to Radiosurgery

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Introduction

Brain metastases are the most common neoplasm of the brain. Gamma-Knife (GK) allows precise radiation of individual lesions. In contrast, classical methods of assessing treatment response use the overall sum of diameters, failing to convey how individual lesions contribute differently to overall tumor burden.

Hypothesis

We hypothesize that a PACS-integrated longitudinal lesion tracking tool (LTT) will facilitate longitudinal lesion tracking for the radiologist and provide information on treatment response of brain metastases after radiosurgery.

Methods

100 patients who underwent GK for metastases were randomly selected and scanned for exclusion criteria. Lesion tracking was performed using PACS-integrated LTT (Vendor) beginning with the GK-scan and followed up to 7 scans, depending on availability. Lesions =>10mm longest diameter (LD) were classified as progressive, receding, or stable if LD increased >20% from nadir, decreased >30% from baseline, or neither, respectively. For lesions < 10mm LD a minimum change of at least 3mm was
needed to classify as changing. Finally, comparing all lesions per patient treatment response was classified as homogenous or as mixed at the last available follow-up study.

Five patients were selected and the amount of clicks necessary to load and measure all lesions with and without the LTT were compared. Paired t-tests corrected for multiple comparisons were used.

**Results**

80 patients were eligible; 494 lesions were measured [mean follow-up: 376 days (Range: 71-1374)]. At last date of follow-up, 77.5%, 15.5%, 1.4%, 5.6% of patients had a mixed; homogenously decreasing, stable, and increasing response to treatment, respectively. Proportion of patients with mixed response increased from 47.6% in patients with 2 lesions (n=17) to 96.5% in those with >4 (n=29).

Loading the images required significantly less clicks with the LTT than without (Average =18.6 vs. 11.4 clicks, p=0.0004), whereas the number of clicks in the measurement did not differ significantly (29.6 vs. 29.8, p=0.838). Overall longitudinal assessment of all lesions using the LTT required less clicks than without (41.3 vs 48.4, p=0.0002).

**Conclusion**

Assessing treatment response of metastatic lesions in the brain allows personalized treatment planning. Our study shows that metastatic lesions in a patient can differ in their response to the same treatment, arguing in favor of tracking individual lesions. Using the LTT reduced the number of clicks necessary in comparison to performing the same measurement without the LTT, reducing the workload for the radiologist. We recommend incorporation of PACS-integrated lesion tracking in clinical practice to better characterize growth changes in patients with metastatic lesions.
Figure 1. The Lesion Tracking Tool (LTT) allows PACS-integrated lesion tracking in a user-friendly manner. Upper panel: View of the LTT during the measurement of a metastatic lesion in the brain. Lower panels: The output of the LTT: Growth Curves (left) and a Lesion Growth Table (right).
Figure 2. Left panel: Diagram showing the proportion of each type of treatment response at the last day of follow-up. Right panel: Comparison of longitudinal lesion measurements with and without using the LTT. Use of the LTT allows for faster lesion tracking. The overall reduction in clicks is the result of the reduction of clicks when loading the images, since the LTT uses a hanging protocol that finds and auto aligns the necessary T1c+ gradient echo images. The number of clicks necessary for the measurement of the lesions itself does not differ.

Keywords

Applications; Clinical Workflow & Productivity

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