

Purpose

Linac-based In stereotactic radiosurgery (SRS) for multiple brain metastases, minimizing normal brain irradiation while maintaining high target conformity is essential to reduce treatment-related toxicity. Both high-dose volume and cumulative low-dose brain exposure have been associated with adverse effects, particularly in patients with multiple lesions. Automatic couch angle optimization has been introduced to improve beam geometry and potentially reduce unnecessary normal brain dose. This study evaluated its dosimetric impact compared with fixed couch angle planning.

Material and Methods:

Fifteen patients with a total of 97 brain metastases were planned using Brainlab Elements Multiple Metastases with dynamic conformal arcs. For each patient, two plans were generated: one using 4-7 automatic couch angle optimization and one using 5 regular fixed couch angles. Paddick Conformity Index (PCI) was evaluated on a lesion basis, and the influence of lesion volume was assessed. Normal brain exposure was evaluated on a patient basis using volumes of brain minus GTV receiving 12Gy (V12), 10Gy (V10), 5Gy (V5), 4Gy (V4), and 3Gy (V3). Paired t-tests and Wilcoxon signed-rank tests were used for statistical comparison.

Results:

No statistically significant difference in PCI was observed between optimized (0.71 ± 0.1) and fixed couch angle plans (0.66 ± 0.1), indicating equivalent target conformity. Lesion volume did not significantly influence PCI nor the difference between planning strategies. Similarly, no statistically significant differences were found between optimized and fixed plans for V12 ($14.9 \pm 7.8 \text{cm}^3$ vs $14.6 \pm 7.6 \text{cm}^3$), V10 ($22.4 \pm 11.6 \text{cm}^3$ vs $22.2 \pm 11.9 \text{cm}^3$), V5 ($103.8 \pm 83.9 \text{cm}^3$ vs $106.6 \pm 89.4 \text{cm}^3$), V4 ($174.7 \pm 151.2 \text{cm}^3$ vs $174.8 \pm 158.6 \text{cm}^3$), or V3 ($319.8 \pm 265.4 \text{cm}^3$ vs $305.4 \pm 259.7 \text{cm}^3$). The number of treated lesions per patient was not associated with low-dose brain exposure or with differences between planning approaches.

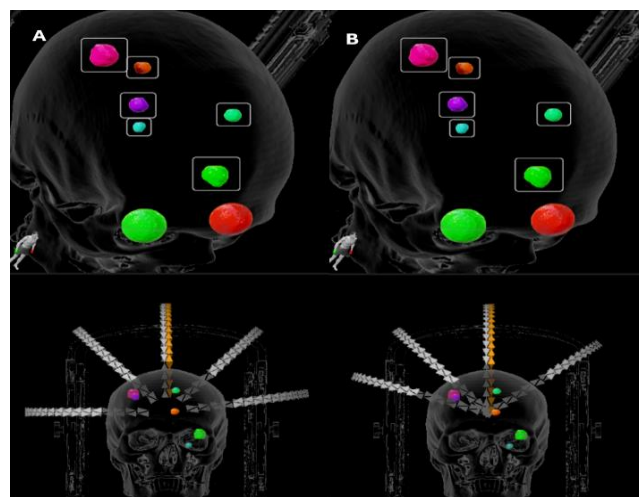


Figure 2. Patient with 6 lesions. (A). Single-isocenter with 5 regular fixed couch angles, arc arrangement and isocenter placement. (B). Optimized couch angles, arc arrangement and isocenter placement.

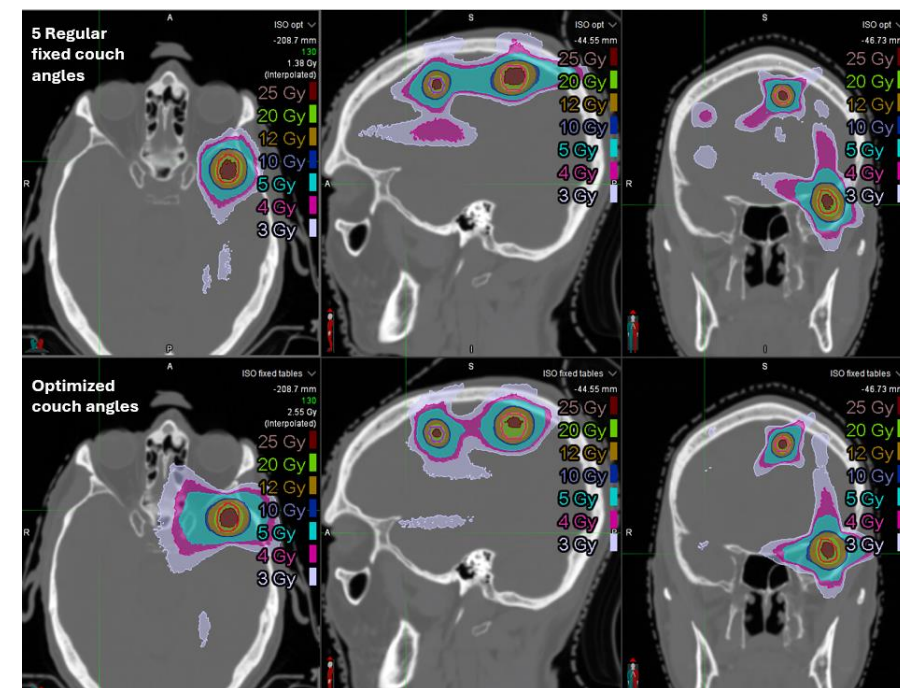


Figure 1. Dose distribution of single-isocenter plan with 5 regular fixed couch angles and a plan with optimized couch angles for a patient with 6 brain metastases. Identical dose color scales and isodose levels are used across the two techniques.

Conclusions:

Automatic couch angle optimization did not significantly improve target conformity or normal brain dose compared with fixed couch angle planning. Lesion volume and lesion number did not modify these findings, suggesting no consistent dosimetric advantage.