

Quantitative Assessment of HyperArc-Based Brain SRS Using Conformity, Gradient, and Normal-Brain Dose Metrics

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OBJECTIVE

To evaluate the dosimetric performance of HyperArc for brain stereotactic radiosurgery (SRS), with a specific emphasis on target-dose conformity, dose gradient fall-off, and normal-brain sparing across varied target sizes.

MATERIALS & METHODS

- Cohort:** 47 HyperArc brain SRS treatment plans evaluated retrospectively.
- Prescription Doses:** 1200 to 2400 cGy.
- Target Volumes (PTV):** 0.6 cc to 23.4 cc.
- Dosimetric Parameters:** D1%, D2%, D5%, D50%, D95%, D98%, D99%, and D100%.
- Plan Quality Metrics:** Conformity Index (CI), Gradient Index (GI), Normalized Conformity Index (NCI), PDIP, and normal-brain V12.
- Statistical Analysis:** Descriptive statistics (mean, median, SD, variance, min, max, 95% CI) and two-sided one-sample t-test comparing CI against the ideal reference value of 1.0.

PLAN QUALITY METRICS SUMMARY

1.036

MEAN CI (± 0.113)

1.039

MEDIAN CI

~100%

PDIP COVERAGE

Low V12

BRAIN SPARING

RESULTS & STATISTICAL ANALYSIS

Statistical Parameter	Conformity Index (CI) Value
Mean $\pm$ Standard Deviation	1.036 $\pm$ 0.113
Median	1.039
Variance	0.0128
Range (Min – Max)	0.50 – 1.40
95% Confidence Interval	1.003 – 1.069
One-Sample t-test (vs. 1.0)	t = 2.18, p = 0.035

- Conformity:** Mean CI (1.036) remained close to unity, indicating excellent overall dose conformity despite statistical deviation ($p = 0.035$).
- Volume Variability:** Higher variability in CI was primarily observed in very small target volumes (< 1 cc).
- Gradient & Sparing:** Steep dose fall-off outside target; normal-brain V12 remained consistently low.
- Target Coverage:** High PDIP values supported consistent, uniform dose coverage.

CONCLUSION

HyperArc delivers highly conformal and steeply falling dose distributions for brain SRS across a wide spectrum of target volumes and doses. Its low overall variability, near-unity mean CI, and strong normal-brain sparing confirm HyperArc as an effective, precise technique for intracranial radiosurgery.

KEYWORDS

Stereotactic Radiosurgery (SRS)

Conformity Index (CI)

Gradient Index (GI)

Normalized Conformity Index (NCI)