

Comparison study of Rapid Arc versus 3D-CRT Plans for Brain, in terms of Dose Volume Histogram (DVH) and Dose Coverage for PTV and OARs.

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OBJECTIVE

- The objective of this study is to compare 3D-CRT versus Rapid Arc plans in brain, in terms of dosimetric outcomes of dose volume histogram (DVH), PTV in terms of D_{mean} , D_{max} and D_{min} covered 95% of the target and the doses of organ at risk (OARs), using linear accelerator (LINAC) with 6 & 15 MV energies.

RESULTS

Table 1.
Evaluation For PTV in terms of D_{mean} , D_{max} and D_{min} covered 95% of the target

	Rapid Arc	3DCRT
D_{mean} (Gy)	54.43±0.656	56.03±0.808
D_{max} (Gy)	54.33±14.737	59.67±1.761
D_{min} (Gy)	44.31±5.820	38.63±10.293
$D_{95\%}$ (Gy)	52.51±0.806	52.43±1.657

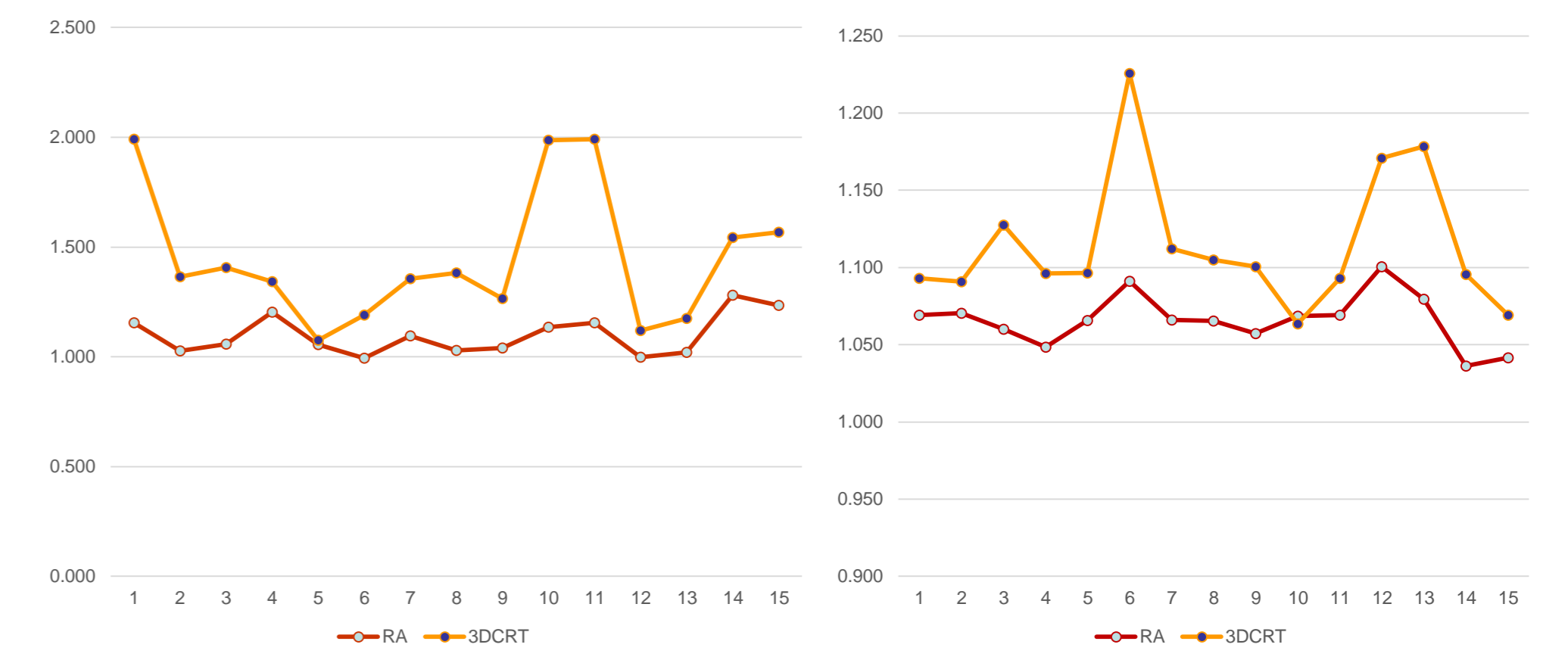


Fig 1. Conformity Index (CI)

Fig 2. Homogeneity Index (HI)

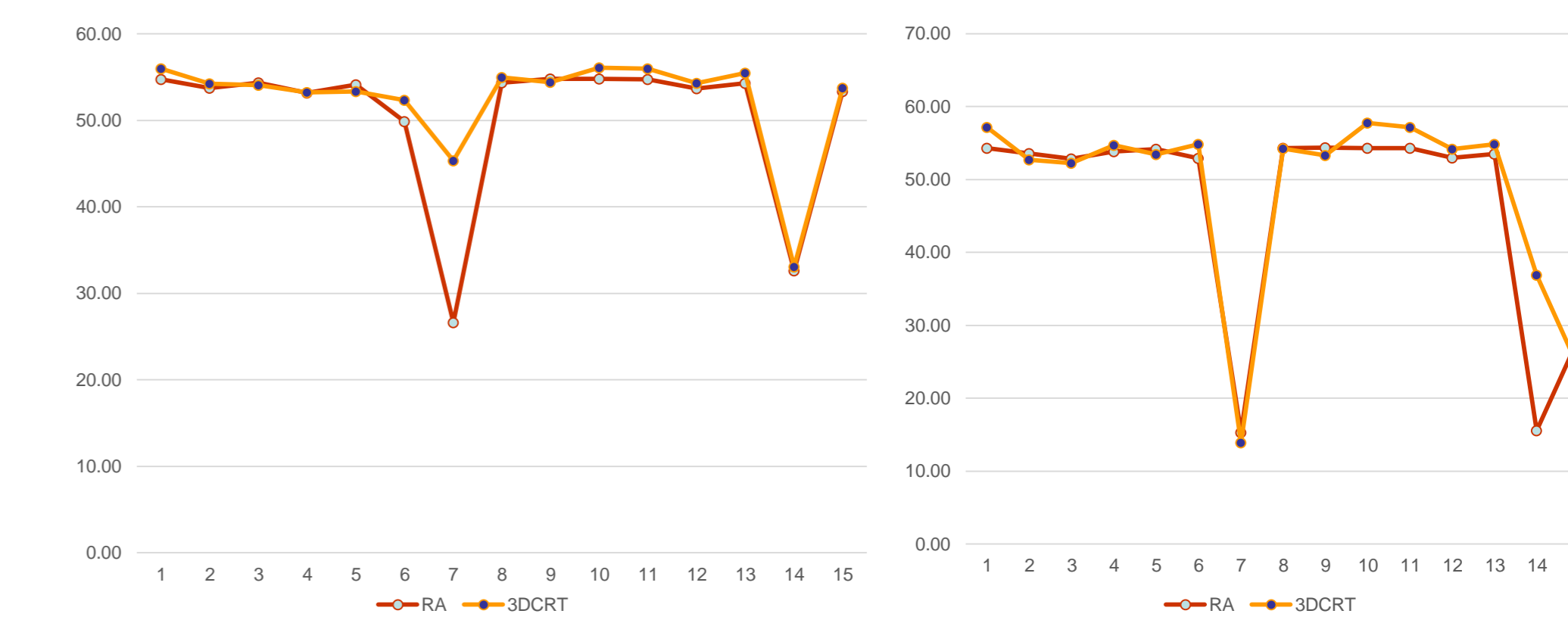


Fig 3. Brainstem (Gy)
Rapid Arc vs 3DCRT

Fig 4. Optic Chiasm (Gy)
Rapid Arc vs 3DCRT



Fig 5. Lt. Optic nerve (Gy)
Rapid Arc vs 3DCRT

Fig 6. LT. Eye (Gy)
Rapid Arc vs 3DCRT

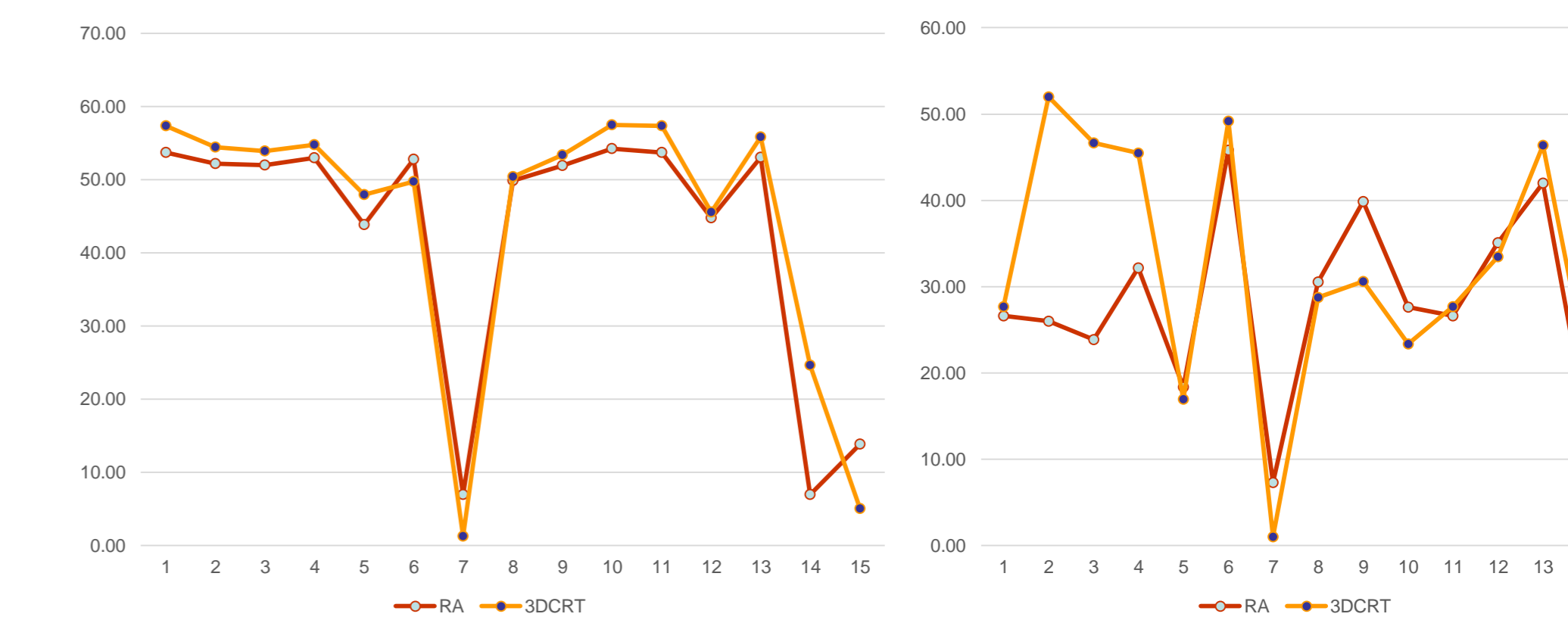


Fig 7. Rt. Optic nerve (Gy)
Rapid Arc vs 3DCRT

Fig 8. RT. Eye (Gy)
Rapid Arc vs 3DCRT

MATERIAL & METHODS

- Plans were created for 15 patients.
- Prescribed dose was 54Gy in 30 fractions, who had received radical Rapid Arc treatment from 2018 to 2019 at SKMCH (Shaukat Khanum Memorial Cancer Hospital and Research Centre).
- The Photon optimizer (PO) was used for the Rapid Arc plans.
- The Anisotropic Analytical Algorithm (AAA) was used for photon dose calculation for all cases.
- The double arc technique was expected to achieve better target dose coverage
- For the 3D-CRT plans, all of the gantry angles and numbers of radiation fields (range, 3-4) were manually selected on the basis of the formalism relationship between the PTV and OARs to cover at least 95% of the PTV and spare the OARs.

Table 2.
Evaluation for the PTV in terms of CI, HI and GI

	Rapid Arc	3DCRT
Conformity Index (CI)	1.099±0.090	1.450±0.311
Homogeneity Index (HI)	1.066±0.016	1.115±0.044
Gradient Index (GI)	3.719±1.459	2.712±1.069

Table 3.
Doses Of Organs at risks

	Rapid Arc	3DCRT	Optimal
Brainstem (Gy)	50.61±8.68	52.44±5.94	Point < 54 Gy
Optic chiasm (Gy)	46.99±14.36	48.76±13.18	Point < 54 Gy
Lt. Optic nerve (Gy)	40.90±13.37	44.26±14.76	Point < 54 Gy
Lt. Eye (Gy)	24.03±11.57	25.23±14.67	Point < 50 Gy
Rt. Optic nerve (Gy)	42.86±17.71	44.62±18.68	Point < 54 Gy
Rt. Eye (Gy)	27.09±11.23	30.09±16.06	Point < 50 Gy

CONCLUSIONS

- The results of this study show that Rapid Arc plan achieved lower mean and maximum doses to the PTV.
- Rapid Arc (VMAT) is superior to 3D-CRT in terms of PTV, conformity and homogeneity over 3D-CRT, Volumetric modulated arc therapy provides better conformity to the tumor, sparing healthy structures and better low-dose OAR.
- All OARs doses were within tolerance in both Rapid Arc and 3D-CRT plans.

