

# Proton vs VMAT Plan Comparison of Patients with Metallic Breast Expanders

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## BACKGROUND:

- Temporary metallic tissue expanders (TE) create unique challenges in treatment planning for postmastectomy radiotherapy in patients with locally advanced breast cancer.<sup>1-3</sup>
- Different attenuation of the x-ray beam of high Z materials and their artifacts could lead to inaccurate dose calculation by Treatment Planning Systems (TPS).
- Sufficient target coverage and better Organs at Risks(OAR) sparing can be achieved by choosing a proper modality and technique that is least affected by the presence of TE.<sup>1-3</sup>

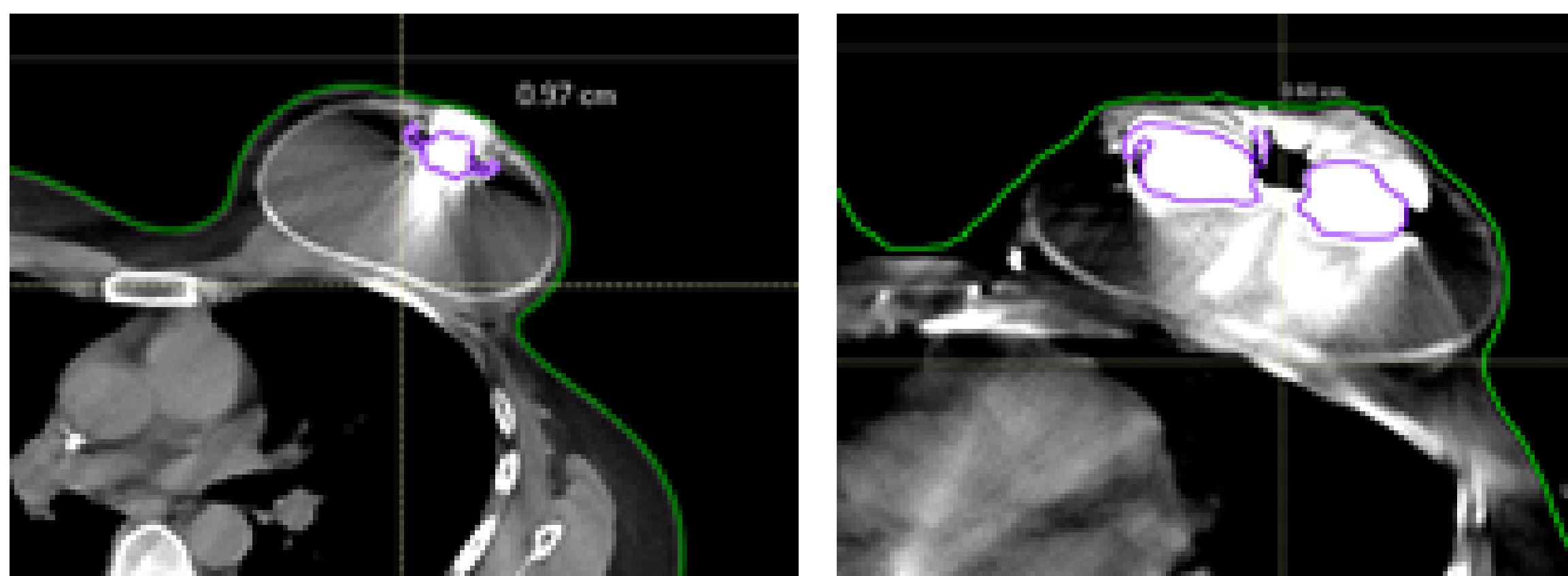


Figure 1. CT scan of breast patients with metallic breast expanders.

## PURPOSE:

To create VMAT plans for breast patients with metallic breast expanders and compare their dosimetric parameters with previously treated proton plans.

## METHODS:

### Patient Data:

12 breast cancer patients (10 left breast, 2 right breast) with metallic breast expanders previously treated with proton therapy (PT) were selected. Seven of them had bilateral implants and one had two ports on the affected breast.

All patients were prescribed to a total dose of 5040cGy (180cGy × 28 fractions).

### Treatment planning:

- Planning Target Volumes (PTV) for VMAT were generated with proper margins on Clinical Target Volumes (CTV) following our clinical guidelines. PTV\_OPT was created by excluding the metal port of the expander from CTV with 5mm margin for VMAT. The density for the metal was overridden to steel for PT.

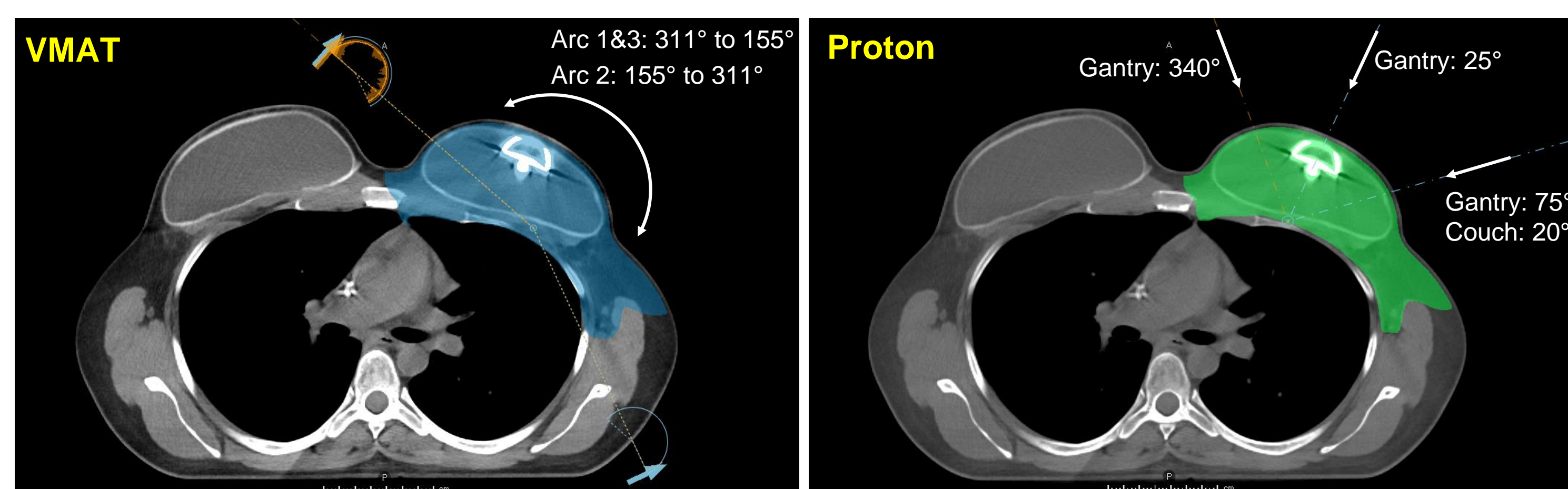


Figure 2. PTV\_OPT and CTV\_OPT contouring for VMAT and Proton plans with arcs and beams used.

Appropriate optimization objectives and settings were used in VMAT plans using RayStation (8A and 11A) TPS to achieve optimal plans and comparable target coverages as PT plans.

### Plans Comparison:

Dose-volume histograms (DVH) parameters for the two plans were compared for each patient.

## RESULTS:

### Proton-VMAT Comparison:

Figure 3 shows the distribution of Proton and VMAT plans. It shows better tissue sparing of the proton plan in the treatment of breast patients with metallic breast expanders.

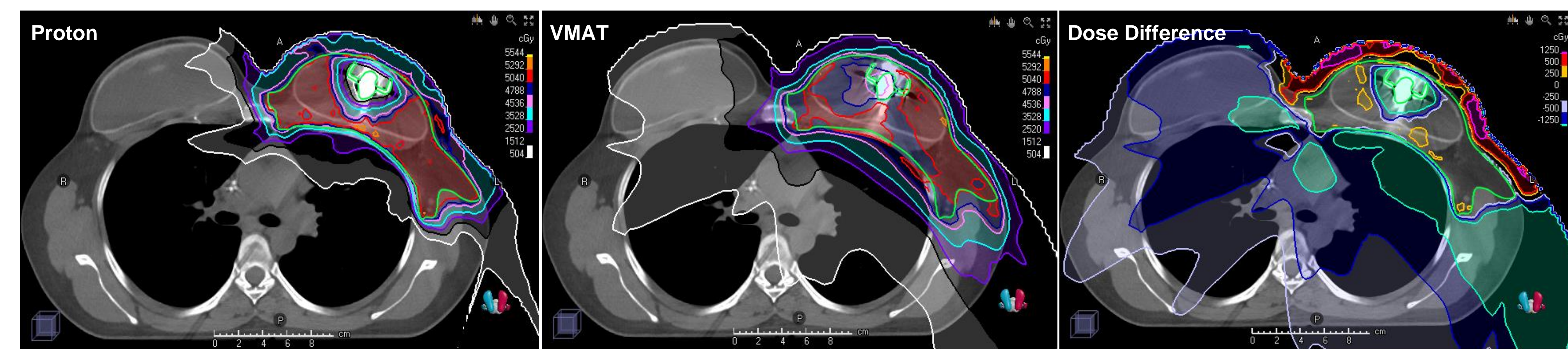


Figure 3. Dose distribution of the proton plan (Left), the VMAT plan (Middle), and the dose difference between two plans (Right).

The CTV coverage of VMAT plans were comparable to that of PT plans with V95>95% of CTV (Figure 4A). Figure 4 (B-F) shows that PT plans compared to VMAT plans have lower dose to the heart, lung, and spinal cord (P-value<0.05).

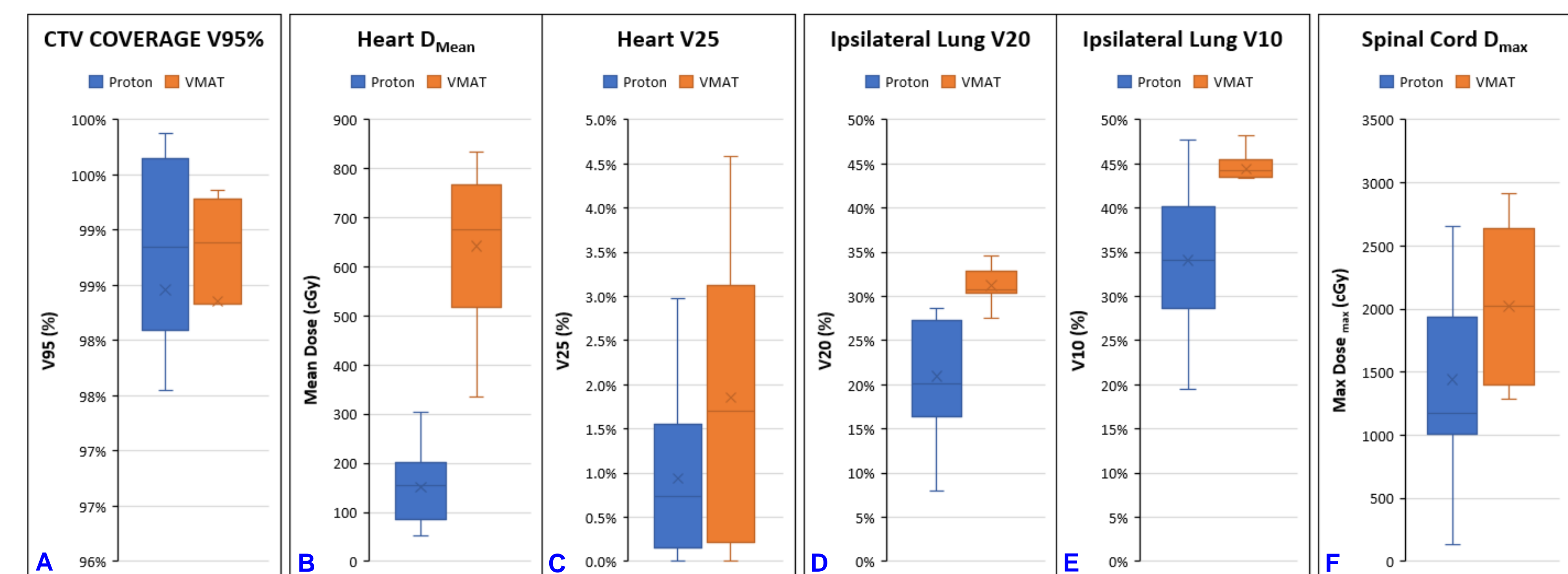


Figure 4. Comparison of DVH parameters between proton and VMAT plans for A) CTV coverage (V95%), B) Heart mean dose C) Heart V25 D) Ipsilateral lung V20, E) Ipsilateral lung V10, and F) Spinal cord maximum dose.

### VMAT Planning Tips:

- The VMAT optimization was slower in the patient with dual port in comparison to the patients with single port on the affected side.
- The presence of the high Z material in the breast expander affect the plan quality as it attenuates the beam differently than tissues, however it has been observed that overriding the density of the metal in VMAT plans makes the optimization significantly slower with no benefit in plan quality.

## CONCLUSION:

- Better OARs (Heart and Ipsilateral Lung) sparing were observed in Proton plans than VMAT with similar targets coverage.
- Overriding the density of the metal in VMAT plans makes the optimization significantly slower with no benefit in plan quality.

## REFERENCES:

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3. Kuo L, Ballangrud SM, Ho AY, Mechalakos JG, Li G, Hong L. A VMAT planning technique for locally advanced breast cancer patients with expander or implant reconstructions requiring comprehensive postmastectomy radiation therapy. *Medical Dosimetry*. 2019; 44(2):150-154.