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Enhancing Breast Cancer Therapy through Hybrid IMRT Radiation Treatment Planning

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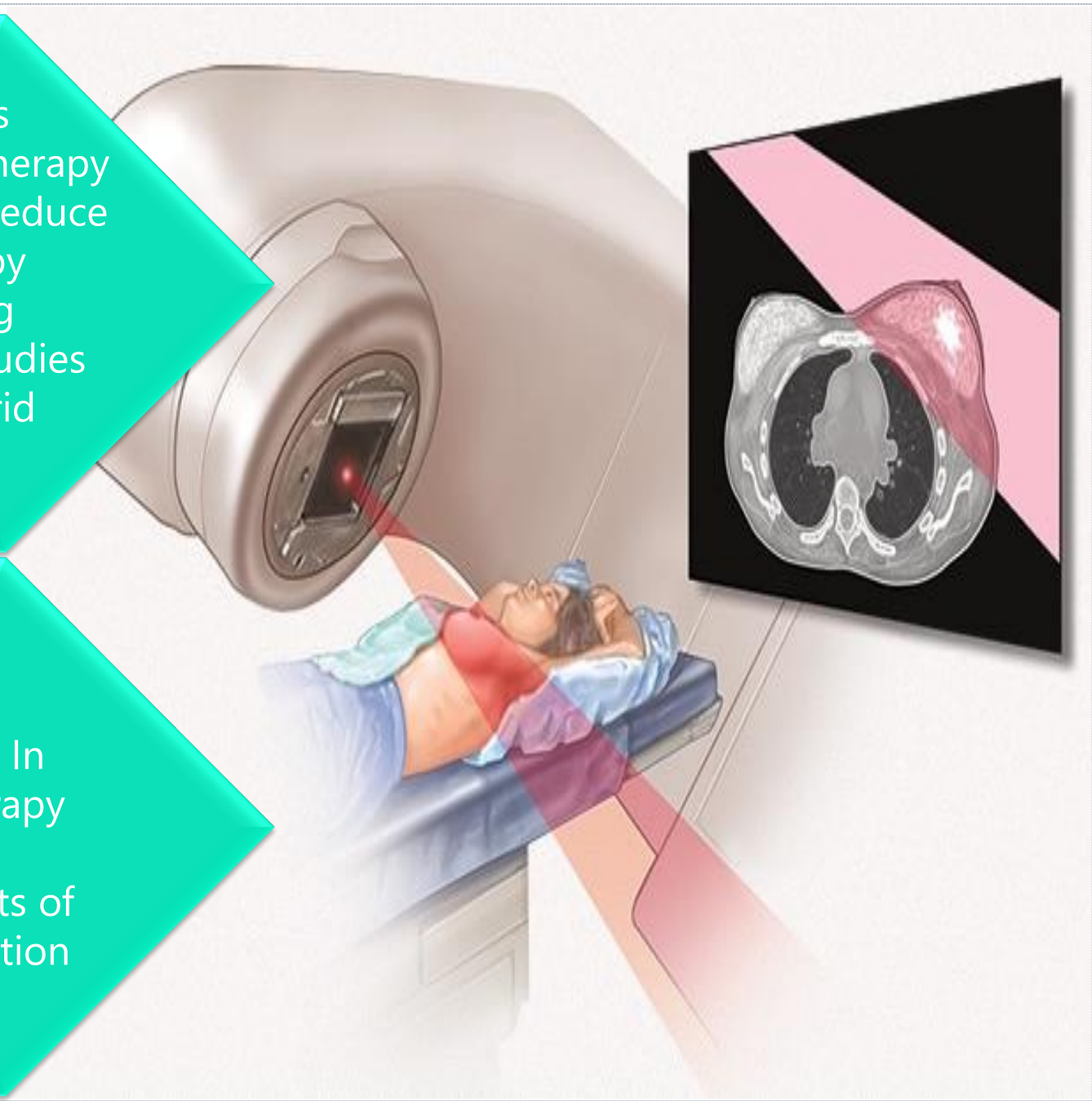
1. Background-Aim

Breast cancer is one of the most common cancers affecting women globally. Optimizing radiation therapy is essential to improve treatment outcomes and reduce side effects. Intensity-modulated radiation therapy (IMRT) offers enhanced dose conformity, reducing radiation exposure to healthy tissues. Previous studies have demonstrated the potential benefits of hybrid IMRT in breast cancer treatment planning.

The aim of the present study is to apply a hybrid method of breast cancer treatment by using a combination of the conventional method of Field In Field (FiF) and Intensity-modulated radiation therapy (IMRT).
The development of this method provides benefits of enhanced dose conformity as well as lower radiation exposure to healthy tissues.



2. Materials & Methods

1. Study Overview
Treatment planning conducted for 20 anonymized left breast cancer patients from the Radiation Therapy Department of Papageorgiou General Hospital, using the Eclipse TPS.

2. Technique
Hybrid IMRT techniques were employed, integrating both static and dynamic beam delivery approaches.

3. Considerations
Patient-specific anatomical considerations and dose constraints were incorporated into the planning process to ensure optimal therapeutic outcomes.

4. Methodology
Our methodology builds upon previous dosimetric comparisons to evaluate the efficacy of hybrid IMRT in breast cancer therapy.

3. Results

Results for Field in Field technique

97.43% of the PTV volume is covered by 95% of the prescribed dose.

Mean volume of the Left Lung receiving 5Gy is 12.27% ± 5.21

Mean volume of the Heart receiving 10Gy is 0.15% ± 0.39

FiF	Mean	Standard Deviation
Dose at 0.03 cc	45.27 Gy	0.56
D2%	44.51 Gy	0.50
D98%	40.37 Gy	0.51
V95%	97.43%	2.22
V107%	0.005%	0.013
Lung V5/Gy (%)	12.27%	5.21
Heart V10/Gy (%)	0.15%	0.39
Monitor Units	303.37	11.73

3. Results

Results for Hybrid IMRT technique

98.84% of the PTV volume is covered by 95% of the prescribed dose.

Mean volume of the Left Lung receiving 5Gy is 11.85% ± 4.73

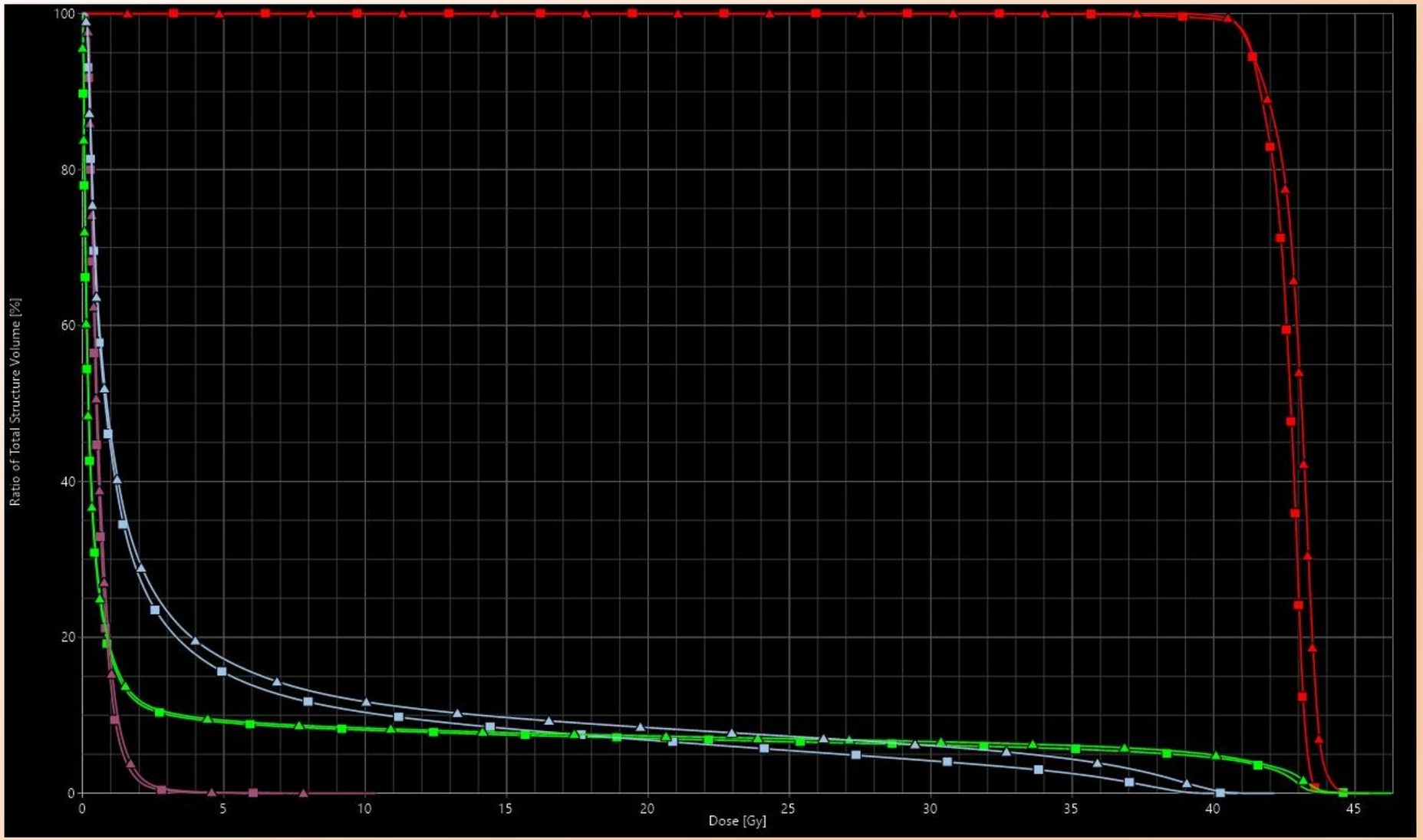
Mean volume of the Heart receiving 10Gy is 0.11%

Maximum Dose delivered and Monitor Units are higher

Hybrid IMRT	Mean	Standard Deviation
Dose at 0.03 cc	44.12 Gy	0.69
D2%	43.91 Gy	0.39
D98%	40.89 Gy	0.56
V95%	98.84%	0.86
V107%	0.098%	0.157
Lung V5/Gy (%)	11.85%	4.73
Heart V10/Gy (%)	0.11%	0.29
Monitor Units	424.26	66.87

3. Results

Comparative DVH between FiF and Hybrid IMRT techniques



3. Results

Statistic Analysis

- Normality checks were performed using the Shapiro-Wilk test.
- Independent samples one- tailed t-tests were performed in order to prove a greater or lower distribution between the two instances.
- Statistically significant differences between the two distributions were observed in the following cases:

1. The minimum, mean and maximum dose in PTV.
2. D2%, D98%, D50%
3. V95%, V107%
4. Monitor units

t-test results showing FiF > Hybrid		
	p - value	
Minimum Dose in PTV	0.01	✗
Mean Dose in PTV	0.02	−
D2%	0.00	✓

t-test results showing FiF < Hybrid		
	p - value	
Total Maximum Dose	0.01	✗
D98%	0.00	✓
V95%	0.00	✓
V107%	0.01	✗
Monitor units	0.00	−

Conformity and Homogeneity Index, Organs at Risk

Percentage analysis of treatment plans showed that the Hybrid IMRT plans exhibit:

	FiF	Hybrid
H.I	9.72	7.12

- ✓ Higher Conformity and Homogenity within the PTV.

	FiF	Hybrid
C.I	0.97	0.99

- ✓ Lower dose received by the Left Lung and Heart by the following percentage:

	Mean	Std
Left Lung	11.8%	3.056%
Heart	11.2%	6.506%

4. Conclusions

- ❑ Our findings highlight the efficacy of hybrid IMRT in enhancing the precision and efficacy of radiation treatment for breast cancer patients.
- ❑ Hybrid IMRT demonstrated superior dose distribution, achieving higher Conformity and Homogeneity within the target volume.
- ❑ The percentage difference between the Hybrid and FiF techniques for Homogeneity and Conformity Index was 30.9% and 1.44% respectively.
- ❑ Mean dose to organs at risk (Left Lung and Heart) was minimized.
- ❑ Dosimetric parameters such D98% and V95% at target volume showed significant statistical improvement.
- ❑ Hybrid IMRT holds promise for improving therapeutic outcomes and quality of life in this patient population.

5. References

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