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Assessment of Dose Distribution and Organ-at-Risk Exposure in VMAT Versus 3D-CRT for Right Breast Cancer

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ABSTRACT

Introduction: Breast cancer is one of the most common malignant tumors worldwide, and radiotherapy plays a crucial role in its treatment. This study compares Volumetric Modulated Arc Therapy (VMAT) and Three-Dimensional Conformal Radiotherapy (3D-CRT) for right-sided breast cancer treatment, focusing on dosimetric parameters.

Material and Methods: This retrospective study included 20 patients with right breast cancer treated at the International Hospital of Khouribga (mean age 52.4 ± 4.9 years; mean body mass index (BMI) 27.2 ± 1.1 kg/m^2). For each patient, two treatment plans were generated: VMAT with dual coplanar arc configuration and 3D-CRT with opposed tangential beams. Analyzed parameters included target volume coverage and doses to organs at risk.

Results: VMAT provided superior target coverage and dose conformity. The mean homogeneity index (HI) was lower with VMAT (0.08 ± 0.02) than 3D-CRT (0.14 ± 0.02), and the conformity index (CI) was higher (0.99 ± 0.01 vs. 0.96 ± 0.02). Mean heart dose was 4.9 ± 0.7 Gray (Gy) with VMAT versus 1.0 ± 0.2 Gy with 3D-CRT; ipsilateral lung mean dose was 13.7 ± 1.5 Gy versus 11.9 ± 0.7 Gy, respectively. Contralateral organs received higher low-dose exposure with VMAT. VMAT achieved improved planning target volume (PTV) coverage and conformity, whereas 3D-CRT provided better contralateral organ sparing.

Conclusion: This study demonstrates VMAT's dosimetric advantages over 3D-CRT for breast cancer treatment, providing institutional validation for technique selection in resource-limited settings.

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Introduction

Breast cancer is one of the leading causes of morbidity and mortality among women worldwide [1]. Radiotherapy plays a fundamental role in breast-conserving treatment by significantly reducing the risk of local recurrence [2]. However, the main challenge lies in achieving optimal tumor control while minimizing radiation exposure to surrounding healthy tissues, particularly the heart and lungs, which are critical organs at risk.

Over the past decades, advances in dose planning and delivery techniques have profoundly transformed clinical practice. Among these, Three-Dimensional Conformal Radiotherapy (3D-CRT) and Volumetric Modulated Arc Therapy (VMAT) occupy a central place.

3D-CRT, a conventional technique based on fixed fields and static multileaf collimators (MLC), allows a conformal dose distribution to the target volume but presents limitations in terms of dose homogeneity and organ-at-risk (OAR) protection. In contrast, VMAT relies on an inverse optimization process that integrates dynamic modulation of beam intensity and rotational motion, enabling improved Planning Target Volume (PTV) coverage and better geometric dose conformity [3].

Several studies have reported the dosimetric advantages of VMAT over 3D-CRT in breast cancer treatment. For instance, Virén et al. [4] and Haciislamoglu et al. [5] demonstrated that VMAT significantly improves the Conformity Index (CI) and Homogeneity Index (HI) while reducing maximum PTV doses. Similarly, Popescu et al. [6] and Rana et al. [7] observed better PTV coverage with VMAT, albeit with a slight increase in low-dose exposure to the lungs and heart. Other works (Wang et al., [8]; Darapu et al., [9]) confirmed these findings, suggesting that the optimal technique should balance tumor coverage with minimal exposure of healthy tissues.

However, limited data exist on the institutional validation of these techniques in resource-limited

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settings. This study aims to establish a baseline dosimetric comparison to guide clinical decision-making and resource allocation at our center. In this context, the present study aims to compare, in Moroccan patients with right breast cancer, the dosimetric performance of 3D-CRT and VMAT techniques, based on plan quality indices (HI, CI) and the dosimetric parameters of the main organs at risk (right lung, heart, contralateral breast, and spinal cord). This comparison will help identify the optimal technique for maximizing tumor control while minimizing toxicity in this patient population.

Materials and Methods

Experimental Protocol Overview

This retrospective analysis involved a cohort of 20 patients diagnosed with right breast cancer who had previously undergone either breast-conserving surgery or partial mastectomy, with no evidence of metastatic disease. The corresponding treatment plans were accessible within the radiotherapy planning system.

Patient demographics are summarised in Table 1. The mean age was 52.4 ± 4.9 years (range 45–60 years). The mean body mass index (BMI) was 27.2 ± 1.1 kg/m² (range 25.4–29.8 kg/m²); all 20 patients were classified as overweight according to the World Health Organization (WHO) criteria. Mean weight and height were 74.2 ± 6.1 kg and 1.65 ± 0.05 m, respectively.

Computed tomography (CT) simulation was conducted using a GE Healthcare (General Electric Healthcare, Chicago, IL, USA) scanner, producing images with a 2.5 mm slice thickness. Patients were positioned supine with both arms elevated. Delineation of target volumes—including the clinical target volume (CTV) and planning target volume (PTV)—as well as organs at risk (OARs) such as the heart, lungs, spinal cord, and contralateral breast, followed contouring recommendations by the International Atomic Energy Agency (IAEA) and the Radiation Therapy Oncology Group (RTOG) [10–13].

Dose prescription and planning objectives were defined in accordance with the International Commission on Radiation Units and Measurements (ICRU) Report 83 [14], ensuring uniformity in reporting and plan evaluation. Normal tissue delineation adhered to established breast radiotherapy contouring guidelines [15,16].

Treatment Planning

For each patient, two radiotherapy plans were generated: one using 3D-CRT with opposed tangential beams and the other using VMAT with a dual coplanar arc configuration.

All plans were designed in the Eclipse® Treatment Planning System (Varian Medical Systems, Palo Alto, USA). The 3D-CRT plans utilized the Monte Carlo dose calculation algorithm, while VMAT plans employed the Anisotropic Analytical Algorithm (AAA),

both recognized for their high accuracy in heterogeneous tissues [17,18,21]. The prescribed radiation dose was 50 Gy in 25 fractions, ensuring that at least 95% of the PTV received the intended dose as per ICRU recommendations [14].

Table 1. Patient demographics

Patient	Age (years)	Weight (kg)	Size (m)	BMI (kg/m²)
P1	53	70,0	1,63	26,3
P2	47	75,0	1,68	26,6
P3	47	73,0	1,62	27,8
P4	58	67,0	1,58	26,8
P5	51	77,0	1,67	27,6
P6	57	71,5	1,64	26,6
P7	57	73,5	1,67	26,4
P8	49	69,5	1,62	26,5
P9	45	70,0	1,66	25,4
P10	49	73,0	1,67	26,2
P11	52	69,0	1,63	26,0
P12	60	72,0	1,64	26,8
P13	53	74,0	1,67	26,5
P14	59	79,5	1,69	27,8
P15	45	85,0	1,73	28,4
P16	47	69,5	1,57	28,2
P17	53	65,0	1,52	28,1
P18	52	84,0	1,72	28,4
P19	55	86,0	1,70	29,8
P20	59	81,5	1,74	26,9
Mean ± SD	52,4 ± 4,9	74,2 ± 6,1	1,65 ± 0,05	27,2 ± 1,1

Dosimetric Indices

To evaluate the effectiveness and precision of dose delivery, two quantitative dosimetric indices were computed [19]:

Conformity Index (CI)

$$\mathrm{CI} = \frac{V_{95}}{V_p} \quad (1)$$

where V_{95} represents the volume receiving ≥95% of the prescribed dose, and V_P is the PTV volume. A CI close to 1 indicates high dose conformity [19].

Homogeneity Index (HI)

$$\mathrm{HI} = \frac{D_2 - D_{98}}{D_{pres}} \quad (2)$$

where D_2 and D_{98} correspond to the doses delivered to 2% and 98% of the PTV, respectively, and Dpres is the prescribed dose. Lower HI values denote better dose uniformity within the target [14,19].

Devices, Software, and Data Used

Treatment planning was carried out using Eclipse®. The 3D-CRT plans employed the Monte Carlo algorithm, while VMAT plans utilized the Anisotropic Analytical Algorithm (AAA), both recognized for their precision in heterogeneous tissue environments [17,18,21].

Treatment delivery was simulated on a Varian Clinac® linear accelerator, equipped with a multileaf collimator (MLC) for beam shaping [22]. CT images were acquired with a GE scanner (2.5 mm slices) and exported in DICOM format for integration into the planning workflow.

Dosimetric Assessments

The key dosimetric parameters evaluated for each technique are detailed below:

Planning Target Volume (PTV)

- D_{98} is the minimum dose that covers 98% of the PTV.
- D_2 corresponds to the dose level above which only 2% of the PTV is exposed, reflecting potential hotspots or overdosage areas within the target.
- Homogeneity Index (HI): Indicator of dose uniformity within the PTV.
- Conformity Index (CI): Measures the geo- metric precision of the dose coverage relative to the PTV.

Organs at Risk (OARs)

- Lungs (left and right): Mean dose (Dmean) and volumes receiving 5 Gy (V5), 10 Gy (V10), 20 Gy (V20), and 30 Gy (V30).
- Contralateral breast: Mean dose (Dmean) and maximum point dose (D1).
- Heart: Mean dose (Dmean) and volume receiving >=10 Gy (V10).

Spinal cord: Maximum dose (Dmax)

Statistical Analysis

Descriptive statistics (mean ± standard deviation) were calculated to summarize all dosimetric parameters. Normality of data distribution was assessed using the Shapiro-Wilk test. Between-group comparisons of dosimetric parameters were performed using the paired Student's t-test for normally distributed data or the Wilcoxon signed-rank test for non-normally distributed data, as the same patients received both treatment plans [23].

Statistical significance was defined as $p < 0.05$. All analyses were conducted using IBM SPSS Statistics version 25 (International Business Machines Corporation, Armonk, NY, USA).

Results

PTV Dosimetric Parameters

The following dosimetric parameters were evaluated to compare the quality of PTV coverage between the two techniques:

D_2: dose received by 2% of PTV
D_{98}: dose received by 98% of PTV
HI: Homogeneity Index
V_{90}: percentage of PTV receiving ≥90% of prescribed dose;
V_{95}: percentage of PTV receiving ≥95% of prescribed dose
CI: Conformity Index
VMAT: Volumetric Modulated Arc Therapy 3D-CRT: Three-Dimensional Conformal Radiotherapy
PTV: Planning Target Volume

Table 2. Comparison of dosimetric parameters for the Planning Target Volume (PTV) between VMAT and 3D-CRT techniques.

Parameter	VMAT	3D-CRT
D_2 (Gy)	51.47 ± 1.11	53.39 ± 0.49
D_{98} (Gy)	47.40 ± 1.46	46.32 ± 1.05
HI	0.080 ± 0.015	0.139 ± 0.020
V_{90} (%)	99.78 ± 0.15	98.84 ± 0.79
V_{95} (%)	98.53 ± 0.89	95.72 ± 2.14
CI	0.986 ± 0.007	0.955 ± 0.021

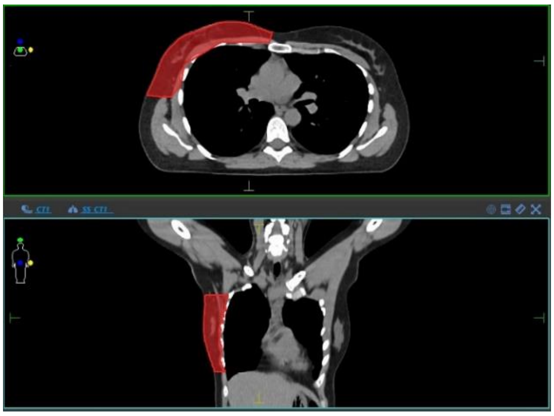


Figure 1. CT slice showing PTV delineation for right-sided breast cancer.

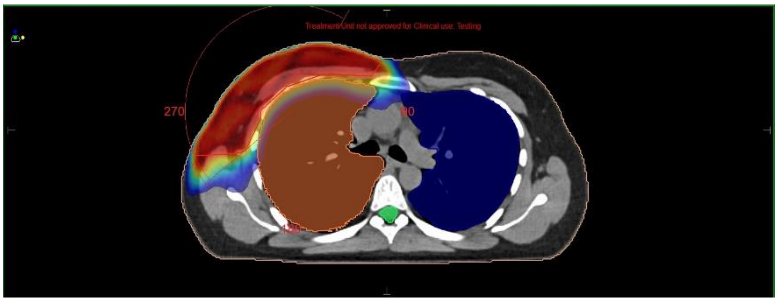
The CT delineation of the planning target volume (PTV) for a representative patient is illustrated in Figure 1. The comparative analysis of dosimetric parameters for the PTV revealed significant differences between the two techniques (Table 2). The maximum dose (D2) was significantly lower with VMAT (51.47 ± 1.11 Gy) compared to 3D-CRT (53.39 ± 0.49 Gy, $p < 0.05$), reflecting better sparing of high-dose regions. Regarding minimum coverage (D98), VMAT achieved a higher value (47.40 ± 1.46 Gy) than 3D-CRT (46.32 ± 1.05 Gy, $p < 0.05$).

The homogeneity index (HI) was significantly lower with VMAT (0.080 ± 0.015) compared to 3D-CRT (0.139 ± 0.020, $p < 0.05$), confirming a more uniform dose distribution. In addition, PTV coverage by the 90% and 95% isodose levels was markedly improved with VMAT (V90 [volume receiving $\geq$90% of prescribed dose] = 99.78 ± 0.15% vs. 98.84 ± 0.79%, $p < 0.05$; V95 [volume receiving $\geq$95% of prescribed dose] = 98.53 ± 0.89% vs. 95.72 ± 2.14%, $p < 0.05$).

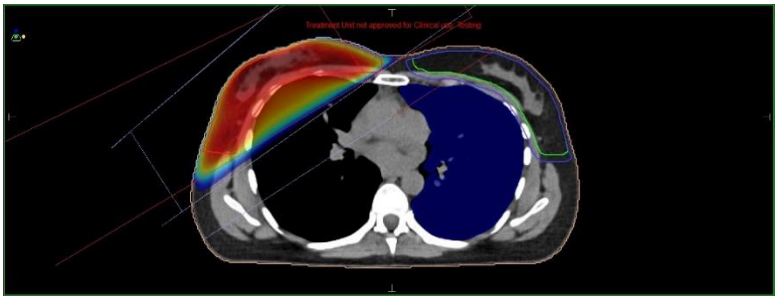
Finally, the conformity index (CI) was significantly higher with VMAT (0.986 ± 0.007) compared to 3D-CRT (0.955 ± 0.021, $p < 0.05$), highlighting the superior agreement between the target volume and the dose distribution achieved with VMAT

Dose Distribution

Isodose distributions for VMAT and 3D-CRT are presented in Figures 2 and 3, respectively.



Figures 2. Isodose distribution (50–107%) in the axial plane for right breast irradiation VMAT.



Figures 3. Isodose distribution (50–107%) in the axial plane for right breast irradiation, 3D-CRT.

Table 3. Comparison of dosimetric parameters for the Organs at risk (OARs) between VMAT and 3D-CRT techniques.

Organ	Parameter	VMAT	3D-CRT	P-value
Ipsilateral Lung	V5 (%)	64.54 ± 13.16	36.56 ± 2.16	<0.05
	V10 (%)	42.49 ± 7.68	25.95 ± 1.50	<0.05
	V20 (%)	22.73 ± 3.17	19.84 ± 3.00	<0.05
	V30 (%)	15.85 ± 2.71	18.88 ± 2.17	<0.05
	Mean Dose (Gy)	13.65 ± 1.52	11.87 ± 0.74	<0.05
Heart	V10 (%)	7.41 ± 2.65	0.00 ±0.00	<0.05
	Mean Dose (Gy)	4.93 ± 0.72	1.04 ± 0.23	<0.05
Left Lung	V5 (%)	14.05 ± 4.24	0.00 ± 0.00	<0.05
	V10 (%)	2.66 ± 1.46	0.00 ± 0.00	<0.05
	Mean Dose (Gy)	2.77 ± 0.50	0.15 ± 0.06	<0.05
Spinal Cord	Max Dose (Gy)	4.94 ± 1.20	0.84 ±0.20	<0.05
Contralateral Breast	D1 (Gy)	12.86 ± 2.35	1.79 ± 0.37	<0.05
	Dmean (Gy)	3.55 ± 0.67	0.22 ± 0.11	<0.05

V5: volume receiving ≥5 Gy; V10: volume receiving ≥10 Gy
V20: volume receiving ≥20 Gy;
V30: volume receiving ≥30 Gy;
Dmean: mean dose;
Dmax: maximum dose;
D1: dose to 1% of volume
VMAT: Volumetric Modulated Arc Therapy;
3D-CRT: Three-Dimensional Conformal Radiotherapy;
OAR: Organ at Risk

Organs at Risk Dosimetric Parameters

The dosimetric analysis of the ipsilateral lung, revealed significant differences between VMAT and 3D-CRT. Low-dose volumes were markedly higher with VMAT (V5 = 64.54 ± 13.16%, V10 = 42.49 ± 7.68%) compared to 3D-CRT (V5 = 36.56 ± 2.16%, V10 = 25.95 ± 1.50%, $p < 0.05$ for both).

For intermediate doses, V20 was slightly higher with VMAT (22.73 ± 3.17%) than with 3D-CRT (19.84 ± 3.00%, $p < 0.05$). In contrast, V30 was significantly reduced with VMAT (15.85 ± 2.71%) compared to 3D-CRT (18.88 ± 2.17%, $p < 0.05$).

The mean dose to the ipsilateral lung was higher with VMAT (13.65 ± 1.52 Gy) than with 3D-CRT (11.87 ± 0.74 Gy, $p < 0.05$), reflecting an overall increase in low-dose exposure.

The dosimetric evaluation of the heart revealed significant differences between VMAT and 3D-CRT.

V10 (%): The heart volume receiving ≥10 Gy was significantly higher with VMAT (7.41 ± 2.65%) than with 3D-CRT (0.00 ± 0.00%, $p < 0.05$).

Mean dose (Gy): The mean dose to the heart was also significantly higher with VMAT (4.93 ± 0.72 Gy) compared to 3D-CRT (1.04 ± 0.23 Gy, $p < 0.05$), reflecting a more pronounced increased low-dose exposure with VMAT.

The dosimetric analysis of the contralateral lung, considered an organ at risk, showed that VMAT resulted in increased low-dose exposure compared to 3D-CRT:

V5(%): 14.05 ± 4.24 % vs. 0.00 ± 0.00% ($p < 0.05$)
V10(%): 2.66 ± 1.46 % vs. 0.00 ± 0.00% ($p < 0.05$)
Mean dose (Gy): 2.77 ± 0.50 vs. 0.15 ± 0.06 ($p < 0.05$)

The dosimetric analysis of the spinal cord revealed significant differences between VMAT and 3D-CRT:

Maximum dose (Gy): VMAT = 4.94 ± 1.20 Gy, 3D-CRT = 0.84 ± 0.20 Gy, $p < 0.05$

The dosimetric analysis of the contralateral breast revealed significant differences between VMAT and 3D-CRT:

D1 (Gy): VMAT = 12.86 ± 2.35 Gy, 3D-CRT = 1.79 ± 0.37 Gy, $p < 0.05$

Mean dose (Gy): VMAT = 3.55 ± 0.67 Gy, 3D-CRT = 0.22 ± 0.11 Gy, $p < 0.05$, (Table 3).

DVH (Dose–Volume Histograms)

Dose-volume histograms for both techniques are shown in Figures 5 and 6.

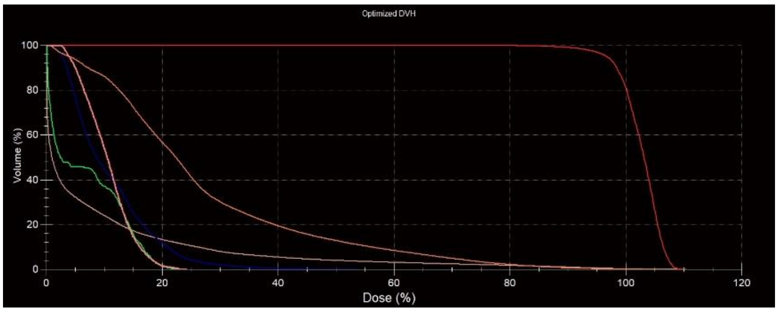


Figure 5. DVH (Dose-Volume Histograms) for 3D CRT plan (right breast cancer)

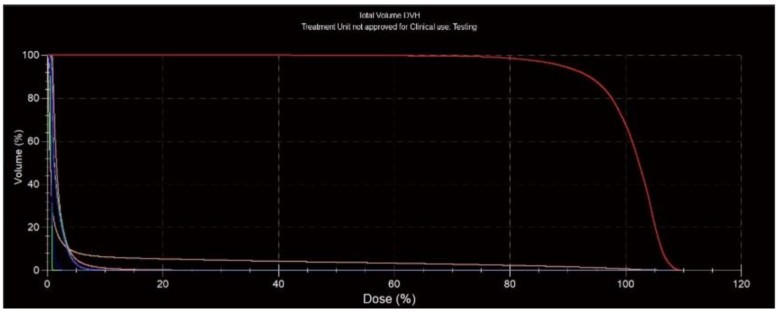


Figure 6. DVH (Dose-Volume Histograms) for VMAT plan (right breast cancer)

Discussion

Dosimetric Performance: PTV Coverage and Dose Distribution

The VMAT technique is based on inverse planning, dynamically adjusting the multileaf collimator aperture, gantry rotation speed, and dose rate to achieve precise geometric adaptation of the dose around the PTV. In this study, VMAT demonstrated superior dose conformity and homogeneity compared with 3D-CRT, consistent with previous findings [14–16]. The improved CI and HI values reflect VMAT's ability to achieve smoother dose gradients and enhanced target coverage.

The 3D-CRT technique provides overall adequate coverage of the planning target volume (PTV), but with a less homogeneous dose distribution and the presence of high-dose regions (>107%) within the treated volume. This pattern reflects the geometrically fixed nature and limited modulation capability of the fields used in this technique. In contrast, VMAT demonstrates a much more homogeneous and conformal dose distribution around the PTV, owing to inverse planning optimization and dynamic intensity modulation during gantry rotation.

The comparison of dose–volume histograms between the 3D-CRT and VMAT techniques (Figures 5 and 6) further demonstrates that VMAT provides better coverage and dose homogeneity for the PTV. The PTV curve is smoother and closer to 100% of the prescribed dose with VMAT, indicating superior conformity.

Organs at Risk: Trade-offs Between Techniques

However, these benefits come with trade-offs. A smoother dose gradient and better sparing of organs at risk (notably the heart and ipsilateral lung) are observed in the high-dose regions with VMAT. Yet, this optimization is accompanied by a slight increase in low-dose exposure to surrounding tissues, particularly the contralateral breast and lung, which is consistent with findings reported in other comparative studies [6, 11, 18, 22, 24, 25].

Ipsilateral Lung

While VMAT reduced high-dose exposure to the ipsilateral lung (V20, V30), it increased the low-dose spread (V5, V10), consistent with observations by Popescu et al. [6] and Bush K et al. [17]. This trade-off between high-dose and low-dose exposure reflects the rotational nature of VMAT, which distributes the dose over a larger volume to improve tumor coverage.

Heart

For the heart, although VMAT resulted in higher mean doses (Dmean: 4.93 ± 0.72 Gy vs. 1.04 ± 0.23 Gy) and V10 values compared to 3D-CRT, these doses remain within clinically acceptable limits [23,24]. Considering the heart as an organ at risk, VMAT increases both low-dose and mean dose exposure compared to 3D-CRT, which could theoretically raise the risk of long-term cardiac complications. However, no portion of the heart receives high doses, which remains favorable for limiting severe cardiac effects. The fixed-beam geometry of 3D-CRT provides superior cardiac sparing for right-sided breast cancer [19,20], aligning with studies suggesting improved cardiac protection [16,21]. Although VMAT slightly increases low-dose exposure, this remains within clinically acceptable thresholds [23,24].

Contralateral Organs

The contralateral lung and breast were better spared using 3D-CRT, due to its fixed-beam geometry minimizing out-of-field radiation [19,20]. VMAT exposes the contralateral lung to increased low-dose exposure, which may increase the risk of diffuse pulmonary toxicity. In contrast, 3D-CRT nearly completely spares this lung, providing better protection for this organ at risk.

Similarly, VMAT exposes the contralateral breast to higher doses than 3D-CRT, both for maximum and mean dose. As an organ at risk, this increased exposure may raise the risk of long-term side effects, such as skin toxicity or secondary malignancy, although the doses remain relatively low compared to critical thresholds.

The dose–volume histograms clearly illustrate this pattern: organs at risk—including the ipsilateral lung, contralateral lung, heart, spinal cord, and contralateral breast—show an increased volume receiving low doses in the VMAT plan compared to the 3D-CRT plan. Thus, although VMAT optimizes dose distribution within the target, it results in more diffuse irradiation of surrounding healthy tissues.

Skin Tolerance

Regarding skin tolerance, both techniques delivered surface doses within acceptable clinical limits. VMAT's smoother modulation minimized hot spots, potentially reducing acute skin reactions—a finding supported by clinical data showing lower rates of erythema and desquamation [25,26]. In this cohort, no severe cutaneous toxicity was observed.

Regional Context and Clinical Implications

This study provides the first comparative dosimetric analysis of VMAT and 3D-CRT specifically for Moroccan breast cancer patients. While the dosimetric advantages of VMAT are well-established globally, regional variations in patient anatomy, body habitus, and resource availability may influence treatment selection. In the Moroccan context, where access to advanced radiotherapy equipment varies across centers, understanding the trade-offs between techniques is essential for informed clinical decision-making. Our findings confirm that both techniques remain clinically valuable, with the choice depending on institutional resources and individual patient characteristics.

Notably, the mean BMI of this Moroccan cohort was 27.2 ± 1.1 kg/m² (range 25.4–29.8 kg/m²), with all patients classified as overweight. This value is higher than the mean BMI typically reported in European and North-American comparative dosimetric studies, which generally ranges between 24 and 26 kg/m². A higher BMI is associated with increased breast volume and greater chest wall thickness, both of which may contribute to wider low-dose irradiation fields and affect the dose homogeneity achieved by each technique. These strengthen the rationale for developing and validating region-specific radiotherapy protocols for Moroccan patients.

This institutional validation provides valuable dosimetric benchmarks for treatment planning in similar clinical settings with comparable patient populations and resource constraints.

Overall, VMAT offers clear dosimetric advantages in PTV coverage and high-dose sparing of the ipsilateral lung, whereas 3D-CRT remains superior for minimizing low-dose exposure to contralateral structures and provides better cardiac sparing for right-sided breast cancer. The choice between these techniques should consider patient anatomy, tumor location, and clinical priorities. Optimization strategies such as Deep Inspiration Breath-Hold (DIBH) or limiting monitor units (MU) can further mitigate VMAT's low-dose exposure while preserving its dosimetric benefits.

Study Limitations

This study has several limitations that should be acknowledged. First, the small cohort size (n=20) limits the generalizability of findings. Second, potential interindividual anatomical variability may influence dosimetric outcomes. Third, this was a purely dosimetric comparison; clinical outcomes such as local control, toxicity rates, and quality of life were not evaluated. Future prospective studies with larger sample sizes and long-term clinical follow-up are needed to validate these dosimetric findings and establish evidence-based treatment recommendations for the Moroccan population.

All treatment plans were reviewed by a board-certified radiation oncologist, and plan evaluation adhered to international protocols and clinical guidelines [10–16].

Conclusion

This study highlights the dosimetric advantages of the VMAT technique compared with 3D-CRT in the treatment of right breast cancer. VMAT provided better target volume coverage and a more conformal dose distribution, while reducing high-dose exposure to critical organs such as the heart and ipsilateral lung. Conversely, 3D-CRT demonstrated superior control of low-dose irradiation to contralateral structures, confirming its reliability in minimizing unnecessary radiation exposure.

These findings suggest that both techniques retain complementary clinical value, and that the optimal choice should be guided by patient anatomy, tumor laterality, and available resources. Personalized radiotherapy planning that takes into account both dosimetric parameters and regional specificities may contribute to improving treatment quality and clinical outcomes for Moroccan breast cancer patients.

Although this study did not specifically evaluate skin toxicity, this clinical aspect deserves further investigation. A prospective analysis correlating dosimetric parameters with local skin reactions would help refine the selection of the most appropriate technique and optimize treatment tolerance.

Therefore, larger multicenter studies with long-term clinical follow-up are needed to confirm these findings and to establish context-specific recommendations for the Moroccan setting.

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