Dosimetric Comparison of Field-in-Field and Intensity-Modulated Radiotherapy Techniques in Bilateral Breast Cancer Radiotherapy[*]

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Abstract

Aim: This study aims to compare the dosimetric parameters, treatment efficiency, and organ-at-risk (OAR) sparing between field-in-field (FinF) and intensity-modulated radiotherapy (IMRT) techniques in the treatment of bilateral breast cancer.

Method: Radiotherapy treatment plans were developed for 10 patients diagnosed with bilateral breast cancer using both FinF and IMRT techniques. Dosimetric parameters, including Dmax, V47.5, V46, D2, D50, and D98 for target volumes, were evaluated. Conformity index (CI) and homogeneity index (HI) were also assessed. Additionally, OAR doses were compared to determine the advantages and disadvantages of each technique. All plans were evaluated in accordance with international standards and quality control protocols.

Results: Both techniques achieved clinically acceptable dose distributions. FinF plans demonstrated lower OAR doses and were more advantageous in terms of treatment time, number of fields, and segment count. Conversely, IMRT plans provided superior dose homogeneity and target coverage. Although IMRT required longer planning and treatment times due to higher segment numbers, OAR doses remained within acceptable limits and were consistent with the literature.

Conclusion: The FinF technique remains a viable and efficient option in bilateral breast cancer radiotherapy, particularly in reducing OAR doses and treatment duration. However, IMRT offers better conformity and dose homogeneity, making it preferable when precise dose distribution is prioritized. Selection of the appropriate technique should be patient-specific, balancing clinical priorities and resource availability.

Keywords: Bilateral breast cancer, radiotherapy, field-in-field, IMRT, dosimetry, organ-at-risk, conformity index, homogeneity index.

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Bilateral Meme Kanseri Radyoterapisinde Alan İçinde Alan ve Yoğunluk Modülasyonlu Radyoterapi Tekniklerinin Dozimetrik Karşılaştırması

Öz

Amaç: Bu çalışmanın amacı, bilateral meme kanseri tedavisinde kullanılan alan içinde alan (FinF) ve yoğunluk ayarlı radyoterapi (YART/IMRT) tekniklerinin dozimetrik parametreler, tedavi etkinliği ve risk altındaki organların (RAO) korunması açısından karşılaştırılmasıdır.

Yöntem: Bilateral meme kanseri tanısı almış 10 hasta için FinF ve IMRT teknikleri kullanılarak radyoterapi planları oluşturuldu. Hedef hacimlere ait Dmax, V47.5, V46, D2, D50 ve D98 dozimetrik parametreleri değerlendirildi. Ayrıca, uyum indeksi (CI) ve homojenlik indeksi (HI) hesaplandı. Risk altındaki organların aldığı dozlar karşılaştırılarak her iki tekniğin avantajlı ve dezavantajlı yönleri belirlendi. Tüm planlar uluslararası kriterler ve kalite kontrol protokolleri doğrultusunda değerlendirildi.

Bulgular: Her iki teknikle de klinik olarak kabul edilebilir doz dağılımı sağlandı. FinF planlarında RAO dozlarının daha düşük olduğu, uygulama süresi, alan sayısı ve segment sayısı açısından daha avantajlı olduğu belirlendi. Buna karşın, IMRT planları doz homojenliği ve hedef hacimlerin kapsanması açısından üstünlük gösterdi. Segment sayısının fazlalığı nedeniyle planlama ve tedavi süresi daha uzun olmasına rağmen, IMRT planlarında RAO dozları literatür ve protokollerle uyumlu bulundu.

Sonuç: FinF tekniği, RAO dozlarını ve tedavi süresini azaltma açısından hala geçerliliğini koruyan, etkili bir tedavi seçeneğidir. Bununla birlikte, IMRT tekniği doz homojenliği ve uyum açısından üstünlük sağladığından, hassas doz dağılımının öncelikli olduğu durumlarda tercih edilebilir. Uygun teknik seçimi, hasta özelinde klinik öncelikler ve mevcut kaynaklar dikkate alınarak yapılmalıdır.

Anahtar Sözcükler: Bilateral meme kanseri, radyoterapi, alan içinde alan, IMRT, dozimetri, risk altındaki organ, uyum indeksi, homojenlik indeksi.

Introduction

The aim of radiotherapy is to destroy cancer cells by direct or indirect effects of ionizing radiation. In radiotherapy treatments, high energy x-rays or different types of radiation are used to destroy cancer cells or prevent their proliferation[1].

Generally, radiotherapy treatments are divided into two: The external treatment techniques known as radiotherapy, radiation is given to the cancerous structure with the help of a device outside the body. Internal radiotherapy, radioactive sources are placed directly into the cancerous structure. These different application methods in radiotherapy vary depending on the type and stage of cancer.

Bilateral external radiotherapy in breast cancer radiotherapy treatments are the most effective and widely used technique. Photons are mostly used in external radiation therapy. This type of radiation is applied to the patient with linac (lineer accelator) devices. It is used for treatment in large areas of the body, and treatments are usually planned for several weeks in daily doses. The aim of radiation therapy is to kill cancer cells, but it often affects normal tissues as it enters and exits the body. Although radiation treatments are very beneficial in bilateral breast cancer cases, some complications may occur in the future[2]. Therefore, while the aim is to destroy the cancerous structure, the protection of healthy normal tissues and organs is among the aims of radiotherapy. While it is planned to give the least biological damage to the organs and tissues close to the

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target tumor structure, it aims to increase the survival rate by reducing regional recurrence in the tumor and its surroundings.

The 10-year survival rate of patients with chemotherapy and radiotherapy after surgery has reached 70%. When it was seen that local control was a serious problem for these patients, studies conducted on this showed that postoperative radiotherapy increased local control. In addition to this increased local control, it was seen that radiotherapy also made significant contributions to distant metastases.

The IMRT technique, described by Rack Mackie in 1993, was developed based on 3D-CRT. In this technique, non-homogeneous and optimized photon beams are used[3]. Although the dose coverage in the target volume was provided at the desired level with 3D-CRT and the risk organ doses were reduced to certain extents, the desired success could not be achieved due to the location of some tumor structures and their proximity to the risk organs.

Radiotherapy treatment technique called IMRT is a more complex technique than the conformal radiotherapy technique, and its use has increased rapidly. It has been shown in many studies that the dose distributions obtained in the plans created with IMRT treatment techniques provide a more homogeneous dose distribution[4].

Material and Methods

Tools and Equipment

This study was conducted at Isparta Private Meddem Hospital Radiation Oncology Unit. The tools and equipment used are listed below:

- Toshiba Aquilion 64 Tomography Simulator
- Varian Eclipse Version 8.6 Treatment Planning System
- Varian Clinac DMX Linear Accelerator
- Breast Immobilization Device
- PTW RW-3 Water Equivalent Solid Phantom
- IBA FC65-p Farmer Type Ion Chamber and DOSE 1 Electrometer
- EPID Portal Dosimeter

Method

This retrospective study was conducted at the Radiation Oncology Unit of Isparta Private Meddem Hospital. Data from 10 patients who had been diagnosed with bilateral invasive breast carcinoma and previously treated at the clinic were used.

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Patients diagnosed with bilateral breast cancer were referred to the radiation oncology unit and their PET/CT or MRI results were examined by the clinic physician and treatment decisions were made. The patients were referred to computerized tomography to perform target volume and risky organ contouring within the framework of certain protocols by the clinic physician.

The CT scan, the patients were informed about the simulation. Radon The patient was placed in a breast immobilization device, and the patient's anatomical changes were examined, and arm angles, wrist position and head positioning were made. The patient's chin was lifted up to prevent the head and neck from entering the treatment areas. After the necessary immobilization was provided, computerized tomography was taken and the images taken with a 3 mm cross-sectional area were transferred to the TPS for contouring by the physician via DICOM.

Target volumes and organs at risk were contoured by the clinician on these sections transferred to the contouring system with the help of ICRU 50, 62 and 83 protocols. PTV (Left breast - Right breast), Left and right lung, heart, spinal cord were contoured by the clinician for bilateral breast cancer radiotherapy. cord and the patient's outer contour (Body) were created. In addition, the patient's treatment dose and fraction number were prescribed. According to this prescription, 2 Gy per fraction (Day) and a dose of 50 Gy was determined, with a total of 25 fractions.

In order to minimize dose calculation errors resulting from electron imbalance in the build-up region, PTV volumes were pulled 5 mm inward from the body contour. A simulation image for a patient whose contouring phase has been completed is given in Figure 1(a).

The structures drawn in the treatment planning system were cross-sectionally checked one by one and the planning phase was started. In the first stage, the patient anatomy was taken into consideration using the FinF technique and plans were created. The internal tangential angles were determined on a patient basis and were determined between 40˚and 230˚gantry angles and the external tangential angles were determined between 300˚and 140˚gantry angles. In determining these angles, the risk was to protect the organs, and the biggest aim was to prevent field overlap and hot dose spots that would occur as a result. The collimator angles were set to 0˚for each patient. 6 MV was used as photon energy in both FinF treatment plans and all IMRT treatment plans. The 50 Gy treatment dose and number of days prescribed by the physician were defined on the TPS. After the dose calculation was made by TPS, protection segments were removed for the inner and outer tangential areas and the maximum temperature values were reduced so that the maximum temperatures were around the protocols (107%).

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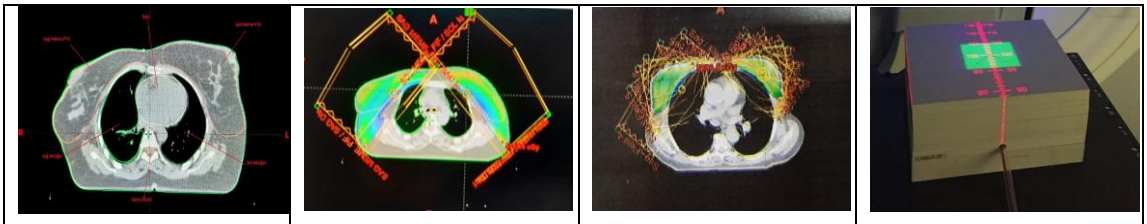
Figure 1. Contoured PTV and risk organ structures (a), Isodose view in axial section in a plan created with the field-in-field treatment technique (b), Bilateral breast treatment plan created with IMRT treatment technique (c), Variant X-Ray output stability measurement setup in clinac DMX linear accelerator (d).



a.	b.	c.	d.

After the maximum hot spots were reduced, isodose curves were drawn and DVH control was performed. In the reference of Emami, RTOG and QUANTEC protocol, values such as V47.5, V46, D50(cm²) and D98(cm²) belonging to PTV volume were found. Conformity and homogeneity index calculations were made using the found PTV values. In addition, V20, V10 and V5 values for the left and right lungs as well as Dmean value were found separately . Spinal The chart was created by finding the Dmax for the cord and Dmean for the heart . MU values affecting patient comfort and treatment duration An example of a plan created with a FinF treatment technique planned in the study is shown in Figure 1(b).

Tangential Following FinF treatments, IMRT treatment plans were created using the inverse treatment technique. In the IMRT technique, based on the internal and external tangential angles used in FinF plans, 6 beam fields ranging from 20 ° to 210 ° were added for each patient in the right breast planning and 6 beam fields ranging from 315 ° to 150 ° in the left breast planning with 20 ° angle differences, respectively. Two different isocenters were used in the IMRT plan designs and the plan centers were adjusted so that there would be a difference only in the lateral plane. Again, 6 MV was selected as the photon energy and the PTV volume was pulled 5 mm inside the body contour.

After all planning parameters were entered, the necessary data for risk organ protections were entered on the optimization screen with appropriate protocols. As a result of all calculations, DVH evaluation was performed and the necessary data was entered into the tables. DVH values were examined over total plans in both FinF plans and IMRT plans. An example of a IMRT treatment plan used in the study is given in Figure 1(c).

After all treatment plans to be compared were completed, the quality control of the IMRT plans was started. For the quality control phase, the output process was started with the help of RW-3 solid water phantoms, FC65-P farmer type ion chamber and Dose 1 electrometer in order to verify the device dose. Varian The gantry and collimator angles of the Clinac DMX Linear Accelerator were set to 0 ° and the solid phantom and ion chamber were installed on the treatment table according to the IAEA TRS 398 protocol as in Figure 1(d). Irradiation was performed at a depth of 10 cm using a 10x10 cm² field

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aperture with a dose rate of 100 MU, 400 MU/ min for a 100 cm SSD and a 6 MV photon beam. Varian The x-ray output -put stability of the Clinac DMX Linear Accelerator was found and the percentage value was evaluated for dose verification.

Task prepared by Klein et al. As stated in the Group 142 report, the acceptance criterion for the x-ray output stability of the linear accelerator device is determined as ±%2 and based on these criteria, Varian Output -put constant control has been made for the Clinac DMX Linear Accelerator device.

After dose verification, quality control plans for 10 IMRT treatment plans were created via TPS and dose maps were created in two dimensions. Varian The gantry and collimator angles of the Clinac DMX Linear Accelerator were set to 0 ° and the quality control of patient plans for IMRT treatments was carried out and it was checked whether the results were within the appropriate protocols. DTA and DD criteria were determined as 3 mm and 3% within these protocols. Plans with a result of 90% and above in gamma analysis were accepted.

Ethical Statement

Study was approved by IGU Non-Interventional Ethics Committee at its meeting dated 19.04.2024 and numbered 2024-05 with the decision number 2024-06-34.

Results

Dosimetric Measurement Results of Varian DMX Device

As a result of the measurement read with the help of the ion chamber and electrometer, the out -put constant value was found to be 100.1 cGy. The measurements were made at 20.3 °C temperature and 1013.2 mbar pressure. Considering these values, the out -put constant given in Table 1 was found to be within the acceptance limits with a difference of +%0.1 and ±%2.

Table 1. 6 MV X-Ray output stability measurement results

Heat	Pressure	Reading Value	Percentage of Difference	Acceptance Criteria
20.3 °C	1013.2 mbar	100.1 cGy	-0.1%	±%2

Target Volume DVH Values of FinF and IMRT Treatment Plans

Varian DVH data of V47.5(%), V46(%), D2(cm²), D50(cm²) and D98(cm²) values formed in PTV volumes over total plans in the plans of FinF and IMRT treatment techniques created with Eclipse Version 8.6 Treatment Planning system are given in Tables 2 and 3. Conformity and homogeneity indices were calculated using these values.

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Table 2. DVH data of target volumes in FinF treatment plans

Patient No.	Dmax (%)	V47.5(%)	V46(%)	D50(cm²)	D98(cm²)	D2(cm²)
1	109.1	91.4	94.2	5049.0	4426.3	5484.0
2	105.6	93.4	96.3	5062.7	4356.8	5264.1
3	108.9	96.8	98.3	5031.8	4165.8	5438.3
4	109.8	95.9	97.1	5022.9	4652.1	5462.0
5	105.2	87.6	93.6	4970.3	4313.9	5278.3
6	107.4	92.5	94.6	5140.6	4065.3	5352.4
7	108.0	92.2	95.2	5142.3	4039.5	5299.0
8	107.8	87.4	91.9	5160.0	4467.5	5318.0
9	109.3	95.4	96.8	5063.2	4542.6	5498.3
10	108.6	89.9	96.1	4993.2	4463.1	5341.6
Average	107.9	91.8	95.4	5049.9	4349.8	5374.6

Table 3. DVH Data of Target Volumes in IMRT Treatment Plans

Patient No.	Dmax (%)	V47.5(%)	V46(%)	D50(cm²)	D98(cm²)	D2(cm²)
1	112.3	96.4	98.2	4977.0	4689.3	5200.1
2	110.1	95.6	96.3	5180.0	4507.3	5371.2
3	108.3	97.1	98.2	5176.3	4703.6	5403.5
4	110.2	97.3	98.6	5022.4	5022.9	5567.2
5	111.8	92.8	99.2	4977.2	4679.3	5201.1
6	110.5	96.0	97.7	5206.3	4540.1	5377.0
7	110.6	96.8	96.8	5192.3	4589.1	5304.6
8	111.4	95.2	95.4	5089.6	4491.5	5253.1
9	112.0	95.6	97.5	5101.2	4496.8	5378.0
10	110.0	95.2	95.8	5218.0	4573.5	5305.6
Average	110.7	95.8	97.4	5116.8	4629.3	5340.7

Left Lung DVH Values of FinF and IMRT Treatment Plans

Varian DVH data of V20(%), V10(%) and V5(%) and Dmean values of the left lung in the plans of FinF and IMRT treatment techniques created with the Eclipse Version 8.6 Treatment Planning system are given in Table 4.

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Table 4. Left lung DVH data of Finf and IMRT treatment plans

Patient No.	FinF				IMRT			
	V20(%)	V10(%)	V5(%)	D mean (cGy)	V20(%)	V10(%)	V5(%)	Dmean (cGy)
1	8	10	13	438.7	17	39	64.8	1162.1
2	11	20	23	708.0	21	37	71.3	1407.5
3	15	18	25	602.9	19	41	56.4	1036.2
4	11	14	17	477.3	23	39	62.4	1210.3
5	19	22	26	1002.0	27	33	60.2	1341.6
6	24	23	33	966.4	24	29	59.8	1485.3
7	11	14	21	720.6	19	23	61.3	1295.2
8	16	19	23	976.3	28	32	69.3	1210.0
9	21	22	27	864.2	24	27	67.0	1432.6
10	17	19	25	929.0	29	34	63.2	1462.3
Average	15.3	18.1	23.3	768.5	23.1	32.1	66.8	1304.8

Right Lung DVH Values of FinF and IMRT Treatment Plans

Varian DVH data of V20(%), V10(%) and V5(%) and Dmean values of the right lung in the plans of FinF and IMRT treatment techniques created with the Eclipse Version 8.6 Treatment Planning system are given in Table 5.

Table 5. Right lung DVH Data of Finf and IMRT treatment plans

Patient No.	FinF				IMRT			
	V20(%)	V10(%)	V5(%)	Dmean (cGy)	V20(%)	V10(%)	V5(%)	Dmean (cGy)
1	10.0	13.0	18.0	601.9	20.0	45.0	63.0	1250.5
2	20.0	24.0	29.0	1100.6	23.0	43.0	68.0	1464.0
3	9.0	13.0	16.0	767.6	28.0	44.0	66.0	1217.6
4	22.0	24.0	27.0	1113.1	27.0	36.0	53.0	1036.6
5	23.0	25.0	28.0	1141.8	29.0	39.0	63.0	1113.4
6	18.0	31.0	33.0	891.3	23.0	42.0	68.0	1485.6
7	20.0	40.0	27.0	1110.3	26.0	45.0	64.0	1341.2
8	13.0	28.0	22.0	878.6	29.0	49.0	62.0	1249.6
9	21.0	26.0	24.0	964.5	22.0	39.0	66.0	1036.2
10	23.0	18.0	32.0	1128.3	27.0	51.0	68.0	1095.4
Average	17.9	24.2	25.6	969.7	25.4	39.4	64.0	1229.0

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Cardiac DVH Values of FinF and IMRT Treatment Plans

Varian DVH data of Dmean values of the heart organ in the plans of FinF and IMRT treatment techniques created with the Eclipse Version 8.6 Treatment Planning system are given in Table 6.

Table 6. Cardiac DVH Data of Finf and IMRT Treatment Plans

Patient No.	FinF Dmean (cGy)	IMRT Dmean (cGy)
1	163.9	622.5
2	123.0	474.0
3	362.7	656.2
4	208.7	540.6
5	448.5	913.0
6	329.3	736.6
7	163.0	873.4
8	230.2	698.3
9	196.5	911.6
10	325.3	649.9
Average	255.1	707.6

Spinal of FinF and IMRT Treatment Plans cord DVH Values

Varian Spinal in the plans of FinF and IMRT treatment techniques created with Eclipse Version 8.6 Treatment Planning system DVH data including Dmax values of the cord organ are given in Table 7.

Table 7. Spinal treatment plans for Finf and IMRT cord DVH data

Patient No.	FinF Dmax (cGy)	IMRT Dmax (cGy)
1	40.9	45.4
2	53.4	103.8
3	66.3	56.0
4	73.3	55.4
5	100.9	58.6
6	55.0	46.9
7	36.9	66.3

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8	38.5	41.9
9	83.4	73.2
10	65.9	59.6
Average	61.5	60.7

Total MU Values of FinF and IMRT Treatment Plans

Varian in the treatment plans created using the FinF technique created with the Eclipse Version 8.6 Treatment Planning system, segments were created manually and MU values were automatically calculated by the planning system. In addition, in the IMRT treatment planning system, segments and MU values were automatically calculated by the planning system. These calculated values are shown in Table 8.

Table 8. MU aluesv of Finf and IMRT Treatment Plans

Patient No.	**FinF**	**IMRT**
	MU	**MU**
1	489.0	937.0
2	586.0	1462.0
3	453.0	1286.0
4	483.0	1098.0
5	446.0	967.0
6	459.0	941.0
7	470.0	1056.0
8	423.0	1043.0
9	442.0	1128.0
10	436.0	1263.0
Average	446.8	1118.1

Homogeneity and Conformity Index Values of FinF and IMRT Treatment Plans

Conformity and homogeneity indexes were found with the help of formulas determined in ICRU, accompanied by data obtained from the treatment planning system, and are given in Table 9.

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Table 9. Conformity and homogeneity index data of Finf and IMRT treatment plans

Patient No.	Conformity Index Data		Homogeneity Index Data	
	FinF	IMRT	FinF	IMRT
1	0.898	0.894	0.209	0.102
2	0.902	0.913	0.179	0.166
3	0.831	0.893	0.252	0.135
4	0.906	0.885	0.161	0.108
5	0.911	0.896	0.194	0.104
6	0.851	0.902	0.250	0.168
7	0.886	0.912	0.244	0.148
8	0.925	0.918	0.165	0.105
9	0.835	0.904	0.188	0.142
10	0.860	0.900	0.175	0.106
Average	0.861	0.868	0.201	0.128

Quality Control Values of IMRT Treatment Plans

As a result of the measurements made in the quality control plans of IMRT treatments created through the treatment planning system, the plan applicability values were found to be over 90%, considering the 3 mm DTA and 3% DD criteria. The quality control results of the plans of the 10 study patients are given in Table 10.

Table 10. Average gamma analysis results for IMRT treatment plans

Patient No.	QA Results (%)
1	96.23%
2	95.76%
3	95.93%
4	97.62%
5	93.84%
6	94.36%
7	94.32%
8	92.05%
9	93.64%
10	91.74%
Average	94.54%

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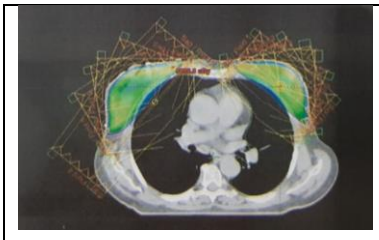
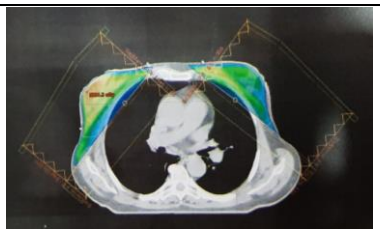
FinF and IMRT DVH values

Thanks to the plan comparison feature provided in the treatment planning system, the DVH values of the FinF and IMRT treatment plans of 10 study patients were compared separately. Some examples of comparison DVHs and plans are as follows.

Figure 2. IMRT treatment plan example patient no:1 (a), FinF treatment plan example patient no:1 (b). FinF and IMRT DVH data example patient no:1 (c), FinF treatment plan example patient no:3 (d), treatment plan example patient no: 5(e), FinF and IMRT DVH data example patient no:2 (f), FinF and IMRT DVH data example patient no: 3 (g)



a



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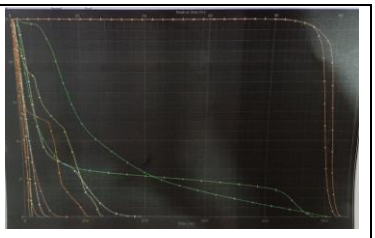

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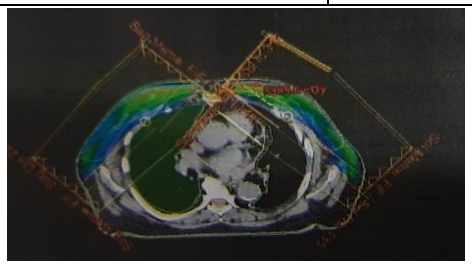

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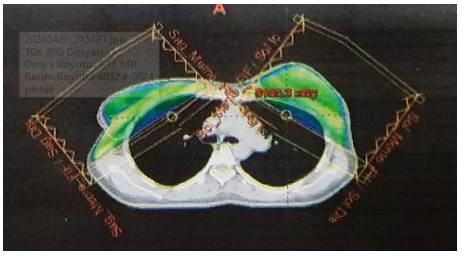

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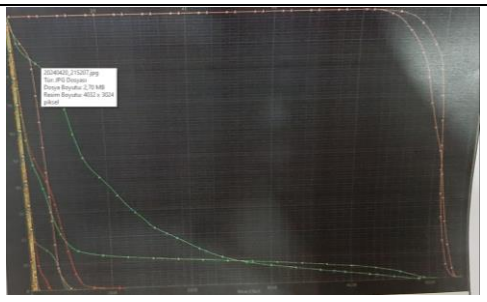

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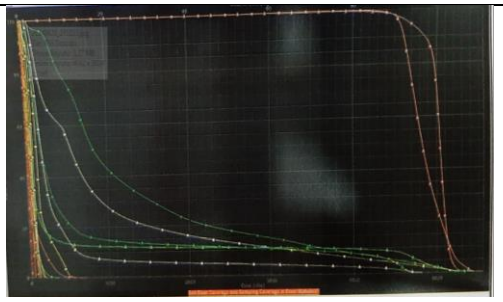

g

Discussion

External radiotherapy in bilateral breast cancer radiotherapy treatments are the most effective and widely used technique. Although radiation treatments are very beneficial in bilateral breast cancer cases, some complications may occur in the future.

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The IMRT technique, described by Rack Mackie in 1993, was developed based on 3D-CRT. In this technique, non-homogeneous and optimized photon beams are used[3]. Although the dose coverage in the target volume was provided at the desired level with 3D-CRT and the risk organ doses were reduced to certain extents, the desired success could not be achieved due to the location of some tumor structures and their proximity to the risk organs.

It has been shown in many studies that dose distributions obtained in plans created with IMRT treatment techniques provide a more homogeneous dose distribution. According to these studies, when IMRT and FinF treatment techniques were compared in terms of dose homogeneity, dose homogeneity and V47.5 and V46 values of PTVs were higher in IMRT treatment plans. Dmax values showed a non-homogeneous distribution within PTVs in FinF plans and covered a larger volume compared to IMRT plans[2-6].

In this study, the target volumes are the Right breast PTV and Left breast PTV. In treatment plans made with FinF technique, V47.5 dose values were found in the range of 87.4% to 96.8%. This value was found in the range of 92.8% to 97.3% for IMRT plans. In addition, while the conformity indexes of FinF plans were in the range of 0.831 to 0.925, these values were found in the range of 0.868 to 0.918 in plans created with IMRT technique. Similarly, for FinF plans, they were in the range of 0.161 to 0.252. homogeneity While finding the indices, this value was found to be between 0.102 and 0.168 for IMRT plans. As a result, a more homogeneous distribution was observed in IMRT plans and it was found to be compatible with the literature.

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In this study, in the comparison made with two planning techniques in similar ways, the DVH parameters of the lungs V20(%), V10(%), V5(%) and Dmean values were evaluated and found to be compatible with other study data. In our study, the DVH data of the lungs in the plans created with the Finf technique are compatible with the literature and lower than the IMRT plans, but these values were found to be within the acceptance limits in the IMRT plans[7,8].

In the study conducted by Ozbay et al., the Dmean values of the heart were examined using 3 different treatment techniques[5]. In our study, the Dmean value of the heart dose in the treatment plans created with the IMRT technique was higher than in the FinF plans. Our values were found to be compatible with the literature and protocols. In addition to these values, spinal cord values were insignificant in both methods and were found to be compatible with the literature[5].

In addition, when the FinF treatment technique is compared with the IMRT treatment technique in terms of segment and MU values, it has been reported in many studies that

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the irradiation time is shorter. In addition, it is known that treatment plans created with IMRT treatment techniques create clinical workload such as quality control.

In our study, the irradiation times of FinF treatment plans were shorter and ranged between 423.0 and 586.0 MU in total treatment areas, while these values ranged between 937.0 and 1462.0 MU in IMRT treatment plans. These values give the total values for two breast irradiations, right and left. In addition, in our study, plan compatibility was found to be 90% and above in the quality controls of IMRT treatment plans and met the acceptance criteria.

Conclusion

In this retrospective study, data from 10 patients diagnosed with bilateral breast cancer were evaluated and the values obtained using two different treatment planning techniques were compared. An attempt was made to determine the treatment technique that was more advantageous and provided optimum results in terms of applicability and could also minimize future complications. For both treatment techniques, bilateral In the defined PTV structures, V47.5, V46, D2, D50, D98 and Dmax values were examined and conformity and homogeneity index data were compared. In addition, right/left lung, heart and spinal cord were identified as risk organs. The doses received by the cord organs were compared. In addition, quality control (QA) of the plans created with IMRT treatment techniques were performed.

In the study, dose wrapping in isodose distributions of target volumes in the plans of 10 bilateral breast cancer patients selected, yielded more acceptable results in the YART treatment technique. Many studies have indicated that there is a risk of recurrence in the region where target dose wrapping is inadequate in the future. At this point, we think that the use of the YART technique in the treatment of bilateral breast cancer is more advantageous in clinical applications.

When the DVH data of the right and left lung organs were examined in the obtained study data, it was seen that some organ doses obtained in the FinF technique were lower. When the high doses in the heart were examined, higher doses were obtained in the plans created with the IMRT treatment technique. Spinal cord doses were found to be insignificantly low for both techniques. Literature inconsistency in organ doses due to uncertainties in the contouring system was observed. Comparison of target volume and risk organ doses for both techniques was found to be consistent with QUANTEC, Emami and also literature studies. Therefore, it is recommended to use the IMRT treatment technique in cases where low coils are thought to be present in PTV doses.

Although there were many advantages in the treatment plans created with the FinF technique in this study, the plans created with the IMRT treatment technique should be preferred in clinical applications in terms of dose wrapping, dose conformity and homogeneity of the target volume. When it is decided to apply this technique, it should be taken into consideration that there will be a longer treatment period due to higher MU values and quality control protocols.

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As a result of this study, it was concluded that IMRT treatments are more beneficial compared to traditional conformal approaches. Among the advantages, a more homogeneous dose distribution in the tumor structure and the fact that risk organ doses are obtained lower in some organs within the literature can be accepted. As disadvantages; long treatment periods and decreasing clinical efficiency, evaluating the dosimetric potential of planning abilities can be mentioned. It is thought that patient immobilization cannot be provided sufficiently during prolonged treatment periods and patient satisfaction can be negatively affected.

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