Jurnal Sains Kesihatan Malaysia 24 (1) 2026: 9-17
DOI : http://dx.doi.org/10.17576/JSKM-2026-2401-02

Quality of Life Following 3D-Conformal Hypofractionated Radiotherapy of Breast Cancer

(Kualiti Hidup Berikutan Radioterapi Hipofractionated Konformal 3D untuk Kanser Payudara)

Fatimah Alaa Hussein[1], Noorazrul Yahya[2], Ummu Afifah Che Rosli[3], Aida W. M. Mohd Mustapha[4], Khairiyah Sidek[5], Rosmizan Ahmad Razali[5], Hanani Abdul Manan[1,3]*

[1]Department of Radiology, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia;
[2]Diagnostic Imaging & Radiotherapy Program, School of Diagnostic & Applied Health Sciences, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Jalan Raja Muda Abdul Aziz, Kuala Lumpur, Malaysia
[3]Department of Radiology and Intervency, Hospital Pakar Kanak-Kanak (Children Specialist Hospital), Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Kuala Lumpur, Malaysia
[4]Department of Radiology, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, Kuala Lumpur 56000, Malaysia
[5]Department of Radiotherapy, Universiti Kebangsaan Malaysia, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia

*Corresponding author: Hanani Abdul Manan
Email address: hanani@ukm.edu.my

Abstract

Purpose: Adjuvant radiotherapy (RT), while effective in reducing cancer recurrence and improving survival rates, often comes with radiation toxicity that can adversely affect the patient's quality of life (QoL). Evaluating toxicity after RT is crucial because it helps to identify and manage adverse effects that can significantly impact a patient's QoL. By monitoring toxicity, we can adjust treatment plans to mitigate these effects, improve patient comfort, and ensure a better overall outcome. Therefore this study aimed to evaluate and compare QoL following 3D-conformal hypofractionated RT in breast cancer patients. Methods: We included twenty-one Malaysian women with unilateral breast cancer treated with lumpectomy (n=15) or mastectomy (n=6) followed by 3D-conformal hypofractionated RT. QoL was evaluated using the EORTC QLQ-BR45 questionnaire before, during, and after RT. Results: During RT, there was a significant increase in the mean score of the breast symptoms scale compared to baseline (p=0.002), with the most common symptoms being skin problems, followed by swelling and oversensitivity. However, these symptoms were generally mild for most patients. The other quality of life scales remained stable during RT. Post-RT, most QoL scales showed improvements compared to both baseline and during RT, with significant enhancements in the mean breast symptoms score and breast satisfaction score (all p<0.05). Conclusion: Radiotherapy negatively impacted the QoL of our breast cancer patients, specifically on the breast symptoms scale. However, these symptoms improved after 4 months, resulting in high breast satisfaction and indicating a near-excellent cosmetic outcome. Future studies with larger cohorts are essential to validate these findings, as the small sample size (n=21 at baseline; n=13 post-RT) may have limited the detection of more subtle changes.

Keywords: Breast cancer; Radiotherapy; Quality of life; Patient-reported breast symptoms

Abstrak

Tujuan: Radioterapi Adjuvant (RT), walaupun berkesan dalam mengurangkan kejadian kanser berulang dan meningkatkan kadar kelangsungan hidup, selalunya datang dengan ketoksikan radiasi yang boleh menjejaskan kualiti hidup (QoL) pesakit. Penilaian ketoksikan selepas RT adalah penting kerana ia membantu mengenal pasti dan mengurus kesan buruk yang boleh memberi kesan ketara kepada kualiti hidup pesakit. Dengan memantau ketoksikan, kami boleh melaraskan pelan rawatan untuk mengurangkan kesan ini, meningkatkan keselesaan pesakit dan memastikan hasil keseluruhan yang lebih baik. Oleh itu, kajian ini bertujuan untuk menilai dan membandingkan QoL berikutan RT hypofractionated 3D-conformal dalam pesakit kanser payudara. Metodologi: Kami menyertakan dua puluh satu wanita Malaysia dengan kanser payudara unilateral yang dirawat dengan lumpektomi (n=15) atau mastektomi (n=6) diikuti oleh RT hypofractionated konformal 3D. QoL dinilai menggunakan soal selidik EORTC QLQ-BR45 sebelum, semasa, dan selepas RT. Keputusan: Semasa RT, terdapat peningkatan ketara dalam skor purata skala simptom payudara berbanding garis dasar (p=0.002), dengan

simptom yang paling biasa ialah masalah kulit, diikuti dengan bengkak dan terlalu sensitif. Walau bagaimanapun, gejala ini secara amnya ringan untuk kebanyakan pesakit. Skala kualiti hidup yang lain kekal stabil semasa RT. Selepas RT, kebanyakan skala QoL menunjukkan penambahbaikan berbanding kedua-dua garis dasar dan semasa RT, dengan peningkatan signifikan dalam skor purata gejala payudara dan skor kepuasan payudara (semua p<0.05). Kesimpulan: Radioterapi memberi kesan negatif kepada kualiti hidup pesakit kanser payudara kami, khususnya pada skala gejala payudara. Walau bagaimanapun, simptom ini bertambah baik selepas 4 bulan, menghasilkan kepuasan payudara yang tinggi dan menunjukkan hasil kosmetik yang hampir cemerlang. Kajian masa depan dengan kohort lebih besar diperlukan bagi mengesahkan dapatan ini, kerana saiz sampel yang kecil (n=21 pra-RT; n=13 pasca-RT) mungkin telah mengehadkan pengesanan perubahan yang lebih halus.

Kata Kunci: Kanser payudara; Radioterapi; Kualiti hidup; Gejala payudara yang dilaporkan oleh pesakit

INTRODUCTION

Adjuvant Radiotherapy (RT) is commonly indicated after breast-conserving surgery (BCS) (Castaneda and Strasser 2017) and in certain cases after mastectomy (Wright and Parekh 2017) to reduce tumour recurrence and improves overall survival (Speers and Pierce 2016). However, RT toxicities are common and distressing, and range in severity from mild symptoms to more severe symptoms that affect the quality of life (QoL), including daily activities, sleeping, sexual functions, body image, and breast cosmetic appearance. Conventional fractionation (CF)-whole breast or chest irradiation has been the standard protocol (55-60 Gy, 2 Gy per fraction for 5 to 6 weeks) which is associated with dose inhomogeneities and excessive irradiation of breast tissue leading to higher toxicity (Tortorelli et al. 2013). Further advances in RT techniques and fractionation schedules have been increasingly introduced to shorten treatment time and improve patients' QoL (Atiq et al. 2022; Ozyigit and Gultekin 2014). Hypofractionated (HF) RT has been associated with less acute skin toxicity and better QoL at the end of RT compared to CF (Arsenault et al. 2020). Three-dimensional conformal RT (3D-CRT) is now considered the recommended technique to deliver RT (Guttmann et al. 2018; Hennequin et al. 2022).

Most of the previous studies have blamed chemotherapy for impairing the QoL (Groenvold 2010; Montazeri 2008). However, few studies have been done to assess the QoL of breast cancer patients following RT with a cross-sectional design in most of them. Some of these studies found a negative impact of RT on QoL during RT (Fuzissaki et al. 2019; Luutonen et al. 2014). Moreover, a large study found that most of the QoL scales improved following RT, but depression/anxiety and future perspectives did not, which necessitated psychosocial support (Rim et al. 2017). However, some studies demonstrated limited or no significant change in the QoL after RT (Lee et al. 2008; Pehlivan et al. 2016; Reidunsdatter et al. 2011; Xiao et al. 2016). These findings necessitate further supporting studies considering the type of RT protocol, and appropriate grouping. Limited studies have investigated the QoL after HF or compared it with baseline findings. Furthermore, very limited data on the use of the updated version of the breast cancer QoL questionnaire (EORTC QLQ BR-45).

The QoL of breast cancer patients after treatment has received increasing concern in the last few years due to the growing number of survivors and the prolonged life span, making it a public health issue. With the introduction of new RT techniques and protocols, there is a persistent demand to assess the QoL in addition to the benefit of these techniques in terms of decreasing recurrence and prolonging survival rates. It is necessary to consider planning, evaluation, and improvements of the QoL after RT. One of the important steps in this management is the development and utilization of validated QoL questionnaires that cover all the side effects of emerging therapeutic modalities. Therefore, the study aimed to evaluate the QoL following 3D-conformal hypofractionated RT of breast cancer using the EORTC QLQ-BR45 questionnaire.

METHODOLOGY

Patients

The participants in this study were adult women with breast cancer treated by BCS or mastectomy and were scheduled to receive RT. They were recruited from the radiotherapy department at Hospital Canselor Tuanku Muhriz (HCTM) during their simulation for RT. The enrolment in this study was between June 2022 and April 2023. The inclusion criteria were: (1) Patients with unilateral non-metastatic breast cancer, (2) no prior RT treatment to the breast or chest, (3) able to understand and communicate in Bahasa Melayu or English, (5). The exclusion criteria were patients having another malignancy.

Patient characteristics including demographic, tumour, and treatment information were collected at baseline from the patients and their medical files. The age of the patients was classified into just two groups during some statistical analysis: young-middle age (< 60 years) and old age (> 60 years). BMI of the patients was calculated using an online BMI metric calculator from the National Institute of Health. The BMI categories in kg/m² applied: Normal weight = 18.5–24.9, Overweight = 25–29.9, Obesity = BMI of 30 or greater.

Ethics Approval Statement

This study was conducted in accordance with the ethical guidelines of the institution and received approval from the Universiti Kebangsaan Malaysia (UKM) Research Ethics Committee. Ethical approval was granted under approval code **UKM PP1/111/8/JEP-2022-307** on **29 April 2022**. All participants provided informed consent prior to participation, and the study adhered to the principles outlined in the Declaration of Helsinki.

Radiotherapy

All patients were treated at HCTM using 3D conformal external photon beam RT with HF approach. The planning of RT included a CT simulation (Toshiba aquillion LB) by placing the patient in a supine position on a breast board with the arm above the head. Then, delineation of the target volume, which includes the clinical (CTV) and planning (PTV) target volumes. Finally, 3-dimensional planning for uniform dose distribution, minimising excessive hot spot regions that may result in a poor cosmetic outcome, and will spare the organs at risk (OAR) (Fig. 1). In our centre, breast cancer cases were treated using the LINAC (linear accelerator) machine from Varian-Clinax IX (Palo Alto, California, US) (Fig. 1). The protocol involved 40 Gy in 15 fractions (2.67 Gy per fraction, 5 daily fractions per week for 3 consecutive weeks). Radiation boost (electron or photon) was administered to patients under 60 years of age who underwent BCS in a range between 10 Gy/5 fractions and 16 Gy/8 fractions over one to one and a half weeks.

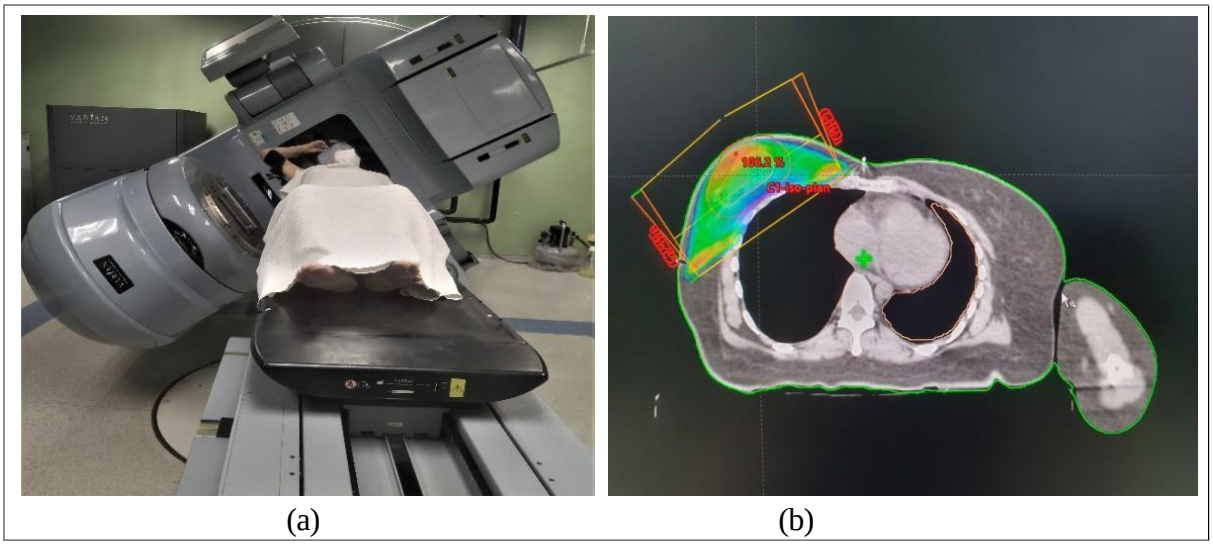

Figure 1. The positioning of breast RT using a machine from Varian-Clinax IX (a) and the tangential field 3D conformal external beam RT to the right breast with 95% isodose coverage. (b) The field given paired with the wedge for better and even coverage.

Quality of life assessment

European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Breast 23 (EORTC QLQ BR23) (Sprangers et al. 1996) was the first breast module from the EORTC core questionnaire (EORTC QoL C30) that was used to assess the QoL of breast cancer patients. It was then updated to EORTC QLQ BR45 due to the significant changes in breast cancer treatment (Bjelic-Radisic et al. 2020) by adding 22 questions related to the satisfaction scale and 3 symptom subscales (endocrine therapy, endocrine sexual, and skin/mucosa). Therefore, the updated questionnaire included 5 functional scales (body image, future perspective, sexual functioning, sexual enjoyment, and breast satisfaction) and 7 symptom scales (arm, breast, endocrine therapy, skin mucositis, endocrine sexual symptoms, systemic therapy side effects, and upset by hair loss).

The questionnaire also has another three options at the end of the questionnaire for any additional problems not covered by the previous items. Each item scores from 1 (not at all) to 4 (very much). High scores on functional scales represent better functioning, and high scores on symptom

scales show more severe symptoms. In our study, the Bahasa Melayu and the English versions of this questionnaire were used to cope with the language abilities and the understanding of the participants. Approval from the EORTC group was obtained to use these versions (request ID: 82288, 99946 for English and Malay versions, respectively). It is a paper and pencil test that was performed in 3 time periods: within one week before RT (baseline), just after the 15 RT sessions (week 3), and after 4 months of RT. At first, we compared all QoL scales in terms of functional and symptom scales before, during, and after RT. As RT has a direct effect on the breast itself, we have also focused on comparing the breast symptoms covered by this questionnaire under the breast symptoms scale: pain, swelling, oversensitivity, and skin problems. The presence of each breast symptom was indicated when the patient scored 2 or higher for each question.

Statistical analysis

Descriptive statistics such as means, standard deviations, frequencies, and percentages were used to describe patient characteristics. Data were also individually checked to identify any discrepancies. Normality distribution of the data was checked using the Shapiro-Wilk test. For comparing the QoL scales and patient-reported breast symptoms before, during, and after RT, the matched paired t-test and Wilcoxon sign ranked tests were used. While comparing between groups, an independent t-test was used. In all tests, p-values less than 0.05 were considered statistically significant. All statistical analysis was performed using Statistical Package for the Social Sciences (SPSS), version 28.0.1.0 (142).

RESULTS

Patient demographics

Twenty-two patients were recruited to participate in the study between June 2022 and April 2023. All of these patients had their baseline evaluation before starting RT. One patient decided to withdraw from the study; therefore, she did not receive a second evaluation during RT. The remaining twenty-one patients were available for data analysis of baseline and second assessments in April 2023. However, only thirteen patients out of twenty-one received a third follow-up assessment after 4 months of RT. The patients were operated between June 2021 and February 2023 by BCS (lumpectomy) (n=16) or mastectomy (n=5). They had a mean age of 53.8 years. Most of the patients were well educated with no smoking history reported by all participants. Half of the patients were overweight (n=5) or obese (n=6).

Twelve patients (57%) had a history of ALND and only 10 patients received boost RT treatment. In addition, most of the patients had received chemotherapy either before (neoadjuvant) or after surgery (adjuvant) and operated < 6 months before starting RT. Particularly, half of our patients were operated on < 3 months before RT. The time between the second and third assessments ranged from 4-8 months (Median, 7). Baseline patients' characteristics and their clinical information are summarized in Table 1.

Table 1. Patient characteristics.

	Mean (SD)	**Median (range)**
Age (years)	53.8 (12.8)	49 (38-74)
Education status (years)	13.3 (3.5)	13 (6-21)
Pre-irradiation BMI (kg/m^2)	26.2 (4.5)	25.2 (17.1-33.9)
Time between surgery and RT (weeks)	19.4 (12.4)	14 (7-57)
Time between 2nd and 3rd assessment (months)	6.3 (1.4)	7 (4-8)
Size of the primary tumour (mm)	32.1 (21.0)	30.0 (1-100)
	N	%
Smoking	0	0%
Menopausal status		
Premenopausal	9	42.9
Postmenopausal	12	57.1
Staging of the tumour		
Low (Stages 0 – II)	10	47.6
High (Stages III – IV)	11	52.4
Grading of the tumour		
Grade 1	6	28.6

continue...

...cont.

Grade 2	7	33.3
Grade 3	8	38.1
Type of breast surgery		
BCS	15	71.4
Mastectomy	6	28.6
Chemotherapy	16	76.2
Antihormone therapy	13	61.9
ALND	12	57.1
Boost treatment	10	47.6

Abbreviations: RT= radiotherapy, SD= standard deviation, BMI= body mass index, BCS= breast-conserving surgery, ALND= axillary lymph node dissection, N= number.

Before RT

The patients had a different performances on their functional scales. The breast satisfaction scale was good to excellent for most patients. In addition, most of the patients experienced a little bit of change in their body image. However, they demonstrated quite a bit of concern about their future health. At the same time, they did not perform well on their sexual functioning and enjoyment scales, especially in the older age groups. On the other hand, most of the patients had a little bit of mild changes in their symptom scales. Although arm symptoms were mild in most patients, they were mostly experienced in patients with axillary lymph node dissection (ALND). Similarly, greater endocrine sexual symptomatology was observed mainly in the younger age patients. Since only twelve patients (57.1%) had hair loss before RT, upset from this hair loss was experienced in only eight patients (66.7%) with a little bit degree of upset, except 2 patients scored severe degree of upset from this hair loss. Therefore, we did not include upset by hair loss in the statistical analysis.

During RT

There were no significant ($p>0.05$) differences in all functional and symptoms subscales when compared to baseline, except for a significantly higher mean score of the breast symptoms scale ($p=0.002$) related to the effect of RT. It was increased in 76.2% of the patients relative to baseline. Most of the patients had a score range in their breast symptoms scale between 2 (little bit) and 3 (quite a bit) out of 4 scores compared to a range between 1 (no change) and 2 (mild changes) before RT. Of the functional scales, only breast satisfaction and sexual enjoyment scales showed a little drop in their mean score during RT. The other functional scales improved slightly. Of the symptoms scales, most of them showed a slight increase in their mean score. The number of patients who had hair loss or were upset by hair loss decreased compared to baseline, but we did not include this scale in the statistical analysis as only seven patients had hair loss (33.3%) and only 5 of them were upset, with a mild degree of severity in most of them.

After RT

Compared to during RT sessions, the mean score of most QoL scales showed improvement, but they reached a significant difference in the breast satisfaction and breast symptoms scales only ($p=0.010$, 0.028, respectively). The mean breast symptoms score decreased in 76.9% of the patients relative to during RT. The range of scores on the breast symptoms scale was between 2 and 3 for half of the patients, and the other half did not have complaints. Compared to baseline scores, the mean score of all QoL scales did not change significantly, except for a significantly improved breast satisfaction scale ($p=0.047$). Although the mean breast symptoms score was higher than the baseline score, it remained similar to the baseline scores in 69.2% of the patients. However, there were better QoL scores in terms of body image, future perspectives, sexual functioning, and systemic therapy symptoms. The other scales slightly dropped after RT compared to baseline. Again, we did not involve the upset by hair loss scale in the statistical analysis because there were only 4 out of 13 patients (30.8%) who had hair loss, and two of them were upset by it in a mild to moderate degree.

Patient-reported breast symptoms

At baseline, breast pain, swelling, oversensitivity, and skin problems were experienced by 66.7%, 4.8%, 23.8%, and 33.3% of the patients, respectively. During RT, the percentages of breast symptoms increased to 85.7%, 38.1%, 52.4%, and 76.2% for breast pain, swelling, oversensitivity,

and skin problems, respectively. The increase was significant in all breast symptoms ($p<0.05$) except breast pain ($p=0.4$). The most significant symptoms experienced by the patients were skin problems ($p=0.005$) followed by swelling ($p=0.01$) and oversensitivity ($p=0.03$) during RT. However, the degree or severity of these symptoms ranged from mild to moderate (a little bit - quite a bit).

After RT, the percentage of each breast symptom non-significantly decreased to 53.8%, 15.4%, 30.8%, and 38.5% for breast pain, swelling, oversensitivity, and skin problems, respectively, relative to during RT sessions ($p>0.05$). Yet, the percentages remained higher than baseline, except for skin problems (all $p>0.05$). Although it decreased after RT, the severity of these breast symptoms was similar to during RT sessions (a little bit - quite a bit degree).

DISCUSSION

Increasing numbers of breast cancer survivors from the significant role of RT in reducing recurrence and prolonging survival rates have directed the work toward improving their QoL. This study is a prospective cohort study to evaluate the QoL of breast cancer patients undergoing RT with an additional focus on breast symptoms due to the direct RT effect. The results demonstrated a significant effect of RT on QoL in terms of breast symptoms compared to baseline with the most significant symptoms reported being skin problems followed by swelling and oversensitivity. This met our expectations, as RT has a direct effect on the breast tissue itself. Some groups of authors (Fuzissaki et al. 2019; Lee et al. 2008; Reidunsdatter et al. 2011) have also found increased breast symptoms during RT. However, the degree of toxicity of breast symptoms was mild to moderate in our study and only one patient reported a severe degree of skin problems during RT. The degree of breast symptoms can be attributed to the uniform dose distribution and highly targeted delivery accomplished by 3D-CRT, which is the protocol in our center in addition to the HF schedule. The latter has been associated with less acute RT toxicities compared to CF (Arsenault et al. 2020; Borm et al. 2021).

The remaining scales of the QoL questionnaire did not show worsening, and little improvements in some aspects of QoL occurred after 15 sessions of RT, as reported by previous studies (Lee et al. 2008; Pehlivan et al. 2016; Reidunsdatter et al. 2011). The latter found significant improvement in future perspectives during RT, which were slightly improved in our study. During RT, patients have already finished their chemotherapy cycles and recovered from the operation and its complications, which usually cause a burden on patients and their families before starting RT. This may result in some improvements or stabilisation of QoL scales during RT excluding breast symptoms. The effect of chemotherapy on hair loss also explains the higher number of patients who had hair loss or were upset by hair loss at baseline which improved after that. The breast satisfaction scale showed a slight drop during RT due to the direct RT effect on the breast and was consistent with the increase in skin problems reported by patients during RT. However, the scale remained good as the baseline score. While decreased sexual enjoyment scale during RT may be related to the stressful situation of breast cancer diagnosis/treatment strategies, especially daily RT session attendance and the older age of some patients who had little interest in sexual issues.

After 4 months of RT, most of the QoL scales showed improvements in functioning or symptoms compared to baseline or during RT sessions. This is in line with some of the previous studies (Lee et al. 2008). Significant improvements were observed only in the breast symptoms scale compared to during RT and the breast satisfaction scale compared to baseline and during RT. Lee et al. (2008) reported a return of breast symptoms scores to baseline at 7 months after RT, and Rim et al. (2017) found a better score with time when comparing at 1, 2, and 3 years. Our finding could result from the recovery of acute side effects of RT that progressed to chronic side effects.

The results of near-excellent breast satisfaction were expected and similar to or slightly higher than the results of most previous studies (McCormick et al. 1989; Fujishiro et al. 2000; Hill-Kayser et al. 2012). This is attributed to the advantage of breast-conserving therapy to preserve the breast cosmetic outcome, and RT did not contribute to decreasing breast satisfaction in our patients. Additionally, 3D-CRT is a major development in the delivery of RT in the breast cancer era due to the critical position of the breast area relative to adjacent vital organs. This protocol preserves the nearby organs from RT damage and improves the breast cosmetic outcome due to the uniform dose distribution and highly targeted delivery. Furthermore, the HF approach also played a role in reducing skin toxicity and improving cosmetic outcomes in our patients, as reported in previous studies (Arsenault et al. 2020; Borm et al. 2021; Wang et al. 2020). However, some patients still complained to a certain degree of some symptoms related to skin mucositis, sexual endocrine therapy, and arm symptoms scales that are mainly related to complications of breast/axillary surgery, antihormone therapy, and chemotherapy.

The strength of the study relies on its prospective cohort nature and involves the use of the updated version of the QoL questionnaire, EORTC QLQ BR45, which is rarely used by previous studies

in this field. Additionally, all assessments were conducted in one centre and were followed by the same assessors to establish consistent evaluations throughout the study period. However, the study involved a small sample size attributed to multiple factors. Furthermore, the study could not compare the QoL with other RT protocols as all patients were treated using the same protocol.

Table 2. The mean score in percentage of the functional and symptom scales of the QoL questionnaire at baseline, during, and post-RT.

Quality of life scales (%) (SD)	Baseline	During	P value	During	After	P value	Baseline	After	P value
Breast satisfaction	78.1± 21.3	71.9± 15.7	0.176	71.9± 15.7	89.6± 11.7	0.010*	78.1± 21.3	89.6± 11.7	0.047*
Body image	39.1± 7.8	37.5 ± 14.4	0.168	37.5 ± 14.4	34.1± 11.8	0.686	39.1± 7.8	34.1± 11.8	0.078
Future perspective	68.7± 31.4	62.5± 14.4	0.739	62.5± 14.4	55.8± 18.1	0.480	68.7± 31.4	55.8± 18.1	0.275
Sexual functioning	37.5± 14.4	43.7± 16.1	0.071	43.7± 16.1	45.8± 23.4	0.914	37.5± 14.4	45.8± 23.4	0.223
Sexual enjoyment	56.2± 12.5	50.0± 20.4	0.527	50.0± 20.4	52.1± 29.1	0.942	56.2± 12.5	52.1± 29.1	0.748
Breast symptoms	31.3± 5.1	45.3± 9.4	0.002*	45.3± 9.4	36.5± 13.9	0.028*	31.3± 5.1	36.5± 13.9	0.733
Arm symptoms	41.7± .8	50.0± 13.6	0.534	50.0± 13.6	42.9± 24.9	0.532	41.7± .8	42.9± 24.9	0.509
Endocrine therapy symptoms	38.7± 11.8	41.2± 10.5	0.829	41.2± 10.5	42.5± 14.3	0.682	38.7± 11.8	42.5± 14.3	0.358
Systemic therapy symptoms	46.4± 10.1	41.9± 13.8	0.424	41.9± 13.8	36.2± 12.3	0.472	46.4± 10.1	36.2± 12.3	0.562
Skin mucositis symptoms	34.4± 12.0	33.3± 7.6	0.080	33.3± 7.6	36.5± 10.6	0.082	34.4± 12.0	36.5± 10.6	0.468
Endocrine sexual symptoms	35.9± 21.9	40.6± 16.5	0.475	40.6± 16.5	40.4± 19.8	0.918	35.9± 21.9	40.4± 19.8	1.000

Abbreviations: QoL= quality of life, RT= radiotherapy, SD= standard deviation
Note: * p value is significant (<0.05)

CONCLUSION

Radiotherapy negatively affected the QoL of our breast cancer patients only in terms of the breast symptoms scale, which improved after 4 months of RT. However, the degree of these symptoms was experienced as a little bit or mild degree in most of the patients. Furthermore, RT did not contribute to worsening or showed some improvements in other QoL scales during and after RT. Finally, the patients were highly satisfied with their breast in terms of breast cosmetic appearance and skin problems after RT compared to baseline and during RT results. The small sample size in the present study (n=21 at baseline; n=13 post-RT) may have limited the sensitivity to detect more nuanced changes. Thus, further studies with a large sample size and longer follow-up are encouraged to assess the QoL and contribute to earlier planning, rehabilitation, and subsequently improving QoL.

ACKNOWLEDGEMENT

The authors thank Jamaluddin Fadzli for his assistance and effort at the beginning of data collection. Many thanks also to all the staff of the radiotherapy department for their help in recruiting patients. Special gratitude to all participants who enrolled in the study and enabled this research to be possible.

FUNDING

This work was funded by the National University of Malaysia under FF-2022-147 ZK grant.

AUTHORS' CONTRIBUTIONS

Most of the authors contributed to the study conception and design. Data collection was carried out by Fatimah Alaa Hussein with the help of

Khairiyah Sidek and Rosmizan Ahmad Razali. The statistical analysis was performed by Fatimah Alaa Hussein and verified by Noorazrul Yahya. The first draft of the manuscript was written by Fatimah Alaa Hussein, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

Arsenault, J., S. Parpia, M. Goldberg, E. Rakovitch, H. Reiter, M. Doherty, H. Lukka, J. Sussman, J. Wright, J. Julian, et al. 2020. "Acute Toxicity and Quality of Life of Hypofractionated Radiation Therapy for Breast Cancer." *International Journal of Radiation Oncology, Biology, Physics* 107 (5): 943–48. https://doi.org/10.1016/j.ijrobp.2020.03.049

Atiq, A., M. Atiq, H. Naeem, N. Saeed, and M. Abbas. 2022. "Modern Radiation Therapy Techniques and Their Toxicities for Breast Cancer." In *Breast Cancer: From Bench to Personalized Medicine*, edited by S. Shakil Malik and N. Masood, 429–51. Singapore: Springer Nature Singapore. https://doi.org/10.1007/978-981-19-0197-3_18

Bjelic-Radisic, V., F. Cardoso, D. Cameron, E. Brain, K. Kuljanic, R. A. da Costa, T. Conroy, E. C. Inwald, S. Serpentini, M. Pinto, et al. 2020. "An International Update of the EORTC Questionnaire for Assessing Quality of Life in Breast Cancer Patients: EORTC QLQ-BR45." *Annals of Oncology* 31 (2): 283–88. https://doi.org/10.1016/j.annonc.2019.10.027

Borm, K. J., J. K. Vennekate, J. Vagedes, M. O. A. Islam, M. N. Duma, M. Loos, S. E. Combs, K. Schiller, S. Klusen, S. Paepke, et al. 2021. "A Comprehensive Prospective Comparison of Acute Skin Toxicity after Hypofractionated and Normofractionated Radiation Therapy in Breast Cancer." *Cancers* 13 (22): 5826. https://doi.org/10.3390/cancers13225826

Castañeda, S. A., and J. Strasser. 2017. "Updates in the Treatment of Breast Cancer with Radiotherapy." *Surgical Oncology Clinics of North America* 26 (3): 371–82. https://doi.org/10.1016/j.soc.2017.01.013

Fujishiro, S., M. Mitsumori, M. Kokubo, Y. Nagata, K. Sasai, K. Mise, and M. Hiroka. 2000. "Cosmetic Results and Complications after Breast-Conserving Therapy for Early Breast Cancer." *Breast Cancer* 7 (1): 57–63. https://doi.org/10.1007/BF02967189

Fuzissaki, M. de A., C. E. Paiva, M. A. de Oliveira, P. P. Lajolo Canto, and Y. C. de Paiva Maia. 2019. "The Impact of Radiodermatitis on Breast Cancer Patients' Quality of Life during Radiotherapy: A Prospective Cohort Study." *Journal of Pain and Symptom Management* 58 (1): 92–99.e1. https://doi.org/10.1016/j.jpainsymman.2019.03.017

Groenvold, M. 2010. "Health-Related Quality of Life in Early Breast Cancer." *Danish Medical Bulletin* 57 (9): B4184.

Guttmann, D. M., P. Gabriel, C. Kennedy, W. Rate, W. Grizos, S. Nagda, and G. M. Freedman. 2018. "Comparison of Acute Toxicities between Contemporary Forward-Planned 3D Conformal Radiotherapy and Inverse-Planned Intensity-Modulated Radiotherapy for Whole Breast Radiation." *The Breast Journal* 24 (2): 128–32. https://doi.org/10.1111/tbj.12857

Hennequin, C., Y. Belkacémi, C. Bourgier, D. Cowen, B. Cutuli, A. Fourquet, and S. Rivera. 2022. "Radiotherapy of Breast Cancer." *Cancer/Radiothérapie* 26 (1): 221–30. https://doi.org/10.1016/j.canrad.2021.11.013

Hill-Kayser, C. E., C. Vachani, M. K. Hampshire, G. A. Di Lullo, and J. M. Metz. 2012. "Cosmetic Outcomes and Complications Reported by Patients Having Undergone Breast-Conserving Treatment." *International Journal of Radiation Oncology Biology Physics* 83 (3): 839–44. https://doi.org/10.1016/j.ijrobp.2011.08.013

Lee, T. S., S. L. Kilbreath, K. M. Refshauge, S. C. Pendlebury, J. M. Beith, and M. J. Lee. 2008. "Quality of Life of Women Treated with Radiotherapy for Breast Cancer." S*upportive Care in Cancer* 16 (4): 399–405. https://doi.org/10.1007/s00520-007-0328-6

Luutonen, S., H. Sintonen, T. Stormi, and E. Salminen. 2014. "Health-Related Quality of Life during Adjuvant Radiotherapy in Breast Cancer." *Quality of Life Research* 23 (4): 1363–69. https://doi.org/10.1007/s11136-013-0554-y

McCormick, B., J. Yahalom, L. Cox, B. Shank, and M. J. Massie. 1989. "The Patient's Perception of Her Breast Following Radiation and Limited Surgery." *International Journal of Radiation Oncology, Biology, Physics* 17 (6): 1299–302. https://doi.org/10.1016/0360-3016(89)90540-3

Montazeri, A. 2008. "Health-Related Quality of Life in Breast Cancer Patients: A Bibliographic Review of the Literature from 1974 to 2007." *Journal of Experimental & Clinical Cancer Research* 27 (1): 32. https://doi.org/10.1186/1756-9966-27-32

Ozyigit, G., and M. Gultekin. 2014. "Current Role of Modern Radiotherapy Techniques in the Management of Breast Cancer." *World Journal of Clinical Oncology* 5 (3): 425–39. https://doi.org/10.5306/wjco.v5.i3.425

Pehlivan, S., A. Kuzhan, Y. Yildirim, and C. Fadiloglu. 2016. "Comfort, Quality of Life and Radiotherapy." *JBUON* 21 (3): 549–55.

Reidunsdatter, R. J., T. Rannestad, J. Frengen, G. Frykholm, and S. Lundgren. 2011. "Early Effects of Contemporary Breast Radiation on Health-Related Quality of Life: Predictors of Radiotherapy-Related Fatigue." *Acta Oncologica* 50 (8): 1175–82. https://doi.org/10.3109/0284186X.2011.604345

Rim, C. H., S. J. Ahn, J. H. Kim, W. S. Yoon, M. Chun, D. S. Yang, and J. Cha. 2017. "An Assessment of Quality of Life for Early

Phase after Adjuvant Radiotherapy in Breast Cancer Survivors: A Korean Multicenter Survey (KROG 14-09).” *Health and Quality of Life Outcomes* 15 (1): 1–9. https://doi.org/10.1186/s12955-017-0673-1

Speers, C., and L. J. Pierce. 2016. “Postoperative Radiotherapy after Breast-Conserving Surgery for Early-Stage Breast Cancer: A Review.” JAMA Oncology 2 (8): 1075–82. https://doi.org/10.1001/jamaoncol.2015.5805

Sprangers, M. A., M. Groenvold, J. I. Arraras, J. Franklin, A. te Velde, M. Muller, and N. K. Aaronson. 1996. “The European Organization for Research and Treatment of Cancer Breast Cancer–Specific Quality-of-Life Questionnaire Module: First Results from a Three-Country Field Study.” *Journal of Clinical Oncology* 14 (10): 2756–68. https://doi.org/10.1200/JCO.1996.14.10.2756

Tortorelli, G., L. Di Murro, R. Barbarino, S. Cicchetti, D. di Cristino, M. D. Falco, and R. Santoni. 2013. “Standard or Hypofractionated Radiotherapy in the Postoperative Treatment of Breast Cancer: A Retrospective Analysis of Acute Skin Toxicity and Dose Inhomogeneities.” *BMC Cancer* 13: 230. https://doi.org/10.1186/1471-2407-13-230

Wang, D., X. Yang, J. He, J. Lin, S. Henry, G. Brown, and M. A. Torres. 2020. “Impact of Regional Nodal Irradiation and Hypofractionated Whole-Breast Radiation on Long-Term Breast Retraction and Poor Cosmetic Outcome in Breast Cancer Survivors.” *Clinical Breast Cancer* 20 (1): 72–80. https://doi.org/10.1016/j.clbc.2019.08.006

Wright, J. L., and A. Parekh. 2017. “Updates in Postmastectomy Radiation.” *Surgical Oncology Clinics of North America* 26 (3): 383–92. https://doi.org/10.1016/j.soc.2017.01.010

Xiao, C., A. H. Miller, J. Felger, D. Mister, T. Liu, and M. A. Torres. 2016. “A Prospective Study of Quality of Life in Breast Cancer Patients Undergoing Radiation Therapy.” *Advances in Radiation Oncology* 1 (1): 10–16. https://doi.org/10.1016/j.adro.2016.01.003