# Comparison of the Efficacy of Different Doses of Intensity-modulated Radiation Therapy After Breast-conserving Surgery for Early-stage Breast Cancer

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**Abstract:** Objective — To investigate the efficacy of different doses of intensity modulated radiation therapy in patients with early breast cancer after breast conserving surgery in order to provide more accurate treatment guidelines for clinical practice to further improve treatment outcomes and quality of life in breast cancer patients. Methods — The main objective of this study was to evaluate the effects of different radiotherapy regimens after breast conserving surgery for early stage breast cancer. The study included 96 patients with early-stage breast cancer who were treated in our oncology department between January 2020 and May 2021. Patients were self-divided into group A and Group B by double-blind method, with 48 patients in each group. Group A received radiation therapy of 50Gy/25Fx for the whole breast after surgery, and an additional dose of 60Gy/25Fx was added to irradiate the tumor bed. Group B received whole breast radiation therapy of 50Gy/25Fx and tumor bed push of 10Gy/5Fx at the same time. The study will compare the differences between the two groups in treatment outcomes, three-year survival, and various adverse events that occur within six months of radiotherapy. Results — When comparing the two groups with different doses of IMRT, the authors focused on the difference in the percentage of the combined volume of prescription dose exposure above the percentage measurement line and the target dose uniformity index. The results showed very significant statistical differences between the two groups for both measures. In addition, it is worth noting that the probability of adverse reactions in group B patients exceeded that in group A, with a statistically significant difference. Conclusion — For patients undergoing breast conserving surgery for early stage breast cancer, receiving radiation therapy with a total dose of 60Gy can significantly improve treatment outcomes. Compared with other dosing regimens, the use of 60Gy intensity modulated radiation therapy can significantly reduce the incidence of adverse reactions while achieving the same therapeutic effect.
***Keywords*:** early-stage breast cancer, breast-conserving surgery, intensity-modulated radiation therapy, therapeutic efficacy comparison

## 1. Introduction

Breast cancer is a malignant tumor occurring in the mammary gland epithelium and is one of the most common malignant tumors in women. The pathogenesis of breast cancer is complex and may be influenced by many factors, including genetic factors, age, estrogen exposure, family history, reproductive factors, obesity, dietary factors, alcohol intake, and long-term use of hormone replacement therapy. Early breast cancer may be asymptomatic, but common signs include breast lumps, breast deformation, sunken skin, nipple discharge, and swelling or redness of the breast. After breast-conserving surgery, high-energy rays or other radioactive substances are usually used to kill residual cancer cells or prevent their growth, in order to reduce the survival and spread of residual cancer cells after surgery, and improve the success rate and cure rate of surgery. Intensity modulated radiation therapy (IMRT) is a modern radiotherapy technique that uses a computer-controlled beam to precisely adjust the dose distribution to achieve more precise irradiation of the target area while reducing damage to surrounding normal tissue.

## 2. Materials and Methods

### 2.1 Data Source

#### 2.1.1 General Information

In this study, a total of 96 patients with early breast cancer who underwent breast-conserving therapy in our hospital from January 2021 to January 2023 were selected as the study objects. According to different radiotherapy regiments, these patients were divided into group A and Group B, each containing 48 patients. In group A, patients ranged in age from 31 to

about 60 years, with a mean age of 43.51±2.58 years. In group B, 48 patients ranged in age from 31 to 58 years, with a mean age of 42.06±2.32 years.

#### 2.1.2 Inclusion criteria

(1) There is a clear case of early breast cancer, that is, a case confirmed by pathology;

(2) The corresponding assessment is mainly carried out by the card scoring system, and the case score should be maintained at more than 70 points, and the life ability and physical health of the case must be ensured within the prescribed range;

(3) Timely exercise of the upper arm in the later period of surgery to ensure that the standard of each position needs to be met during the later period of radiotherapy;

④ The study was approved by the Ethics Committee of our Institute and fully met the prescribed standards of research compliance and ethics.

Exclusion criteria: ① women in pregnancy; ② Patients with early chest wall radiotherapy; ③ Patients who left the study during treatment.

### 2.2 Research Methods

According to the tumor stage and lesion characteristics of different patients, the authors formulated corresponding radiotherapy protocols for group A and Group B patients respectively. In group A, patients received a total dose of 60Gy, a single dose of 2Gy per radiotherapy, and 30 radiotherapy sessions needed to be completed. The total dose of radiotherapy received by group B was 50Gy, and the single dose of each radiotherapy was 2Gy, requiring 25 radiotherapy sessions.

### 2.3 Observation Indicators

The patient's response needs to be evaluated between six months of treatment, and the uniformity of the dose distribution in the target area of each radiometric IMRT is compared. The distribution of the dose in the target area was effectively measured by corresponding indexes, including V95%, V100%, V105% and V115%, respectively. The above indicators show the percentage of volume in the target area that reaches a specific percentage dose. The dose uniformity was mainly evaluated by the uniformity index obtained from the target dose.

### 2.4 Statistical Processing

SPSS statistical software was used to process the data, and the mean plus or minus standard deviation was mainly presented as measurement data. The differences of each group were compared by T-test. The number of cases mainly represents the statistical data, and whether the differences between them are statistically significant needs to be evaluated by $\chi 2$ test. $P<0.05$ is mainly used as a criterion to evaluate whether the differences between different groups are statistically significant.

## 3. Results

### 3.1 Comparison of target area dose distribution uniformity after receiving different radiation dose-modulated radiotherapy

The comparisons were made for target area volumes V95%, V105%, V115%, and HI. According to the results, there were significant statistical differences in these different indicators between the two groups. Table 1 presents the detailed data for the comparison of target area dose distribution uniformity after receiving different radiation dose-modulated radiotherapy.

**Table 1. Comparison of target area dose distribution uniformity after different radiation dose-modulated radiotherapy ($\bar{x}$±S)**

| Group | Number of cases | V95% (%) | V100% (%) | V105% (%) | V115% (%) | HI |
|---|---|---|---|---|---|---|
| Group A | 48 | 97.04±1.80 | 55.76±9.42 | 21.18±9.88 | 6.21±0.63 | 1.17±0.09 |
| Group B | 48 | 99.42±0.78 | 54.39±9.78 | 7.07±1.87 | 1.19±0.42 | 1.25±0.12 |
| T-value | | 5.512 | 1.341 | 5.011 | 6.679 | 5.012 |
| p-value | | 0.021 | 0.851 | 0.019 | 0.029 | 0.022 |

### 3.2 Comparison of treatment effect and long-term survival rate between the two groups

Additionally, the survival rates of patients in Groups A and B were compared over a three-year period following radiotherapy. The results indicated that, according to statistical measures, there was no significant difference in survival rates between the two groups. Detailed reference data can be found in Table 3.

**Table 2. Comparison of treatment outcomes at 6 months after intervention in the two patient groups [cases (%)]**

| Group | Number of cases | Remarkable | Effective | In vain | Total effectiveness |
|---|---|---|---|---|---|
| Group | 48 | 26 (54.17) | 12 (25.00) | 4 (8.33) | 42 (87.50) |
| Group | 48 | 21 (43.75) | 10 (20.83) | 8 (16.67) | 39 (81.25) |

Note: In the intergroup comparison, $\chi 2=12.823$, P=0.001.

**Table 3. Comparison of long-term survival rates after intervention in the two patient groups [cases (%)]**

| Group | Number of cases | 1 year | 2 years | 3 years |
|---|---|---|---|---|
| Group A | 48 | 44 (91.67) | 45 (93.75) | 46 (95.83) |
| Group B | 48 | 42 (87.5) | 44 (91.67) | 45 (93.75) |
| $\chi^2$ value | | 3.293 | 3.982 | 4.238 |
| p-value | | 0.009 | 0.102 | 0.079 |

### 3.3 Comparison of adverse reactions between the two groups

Due to erythema in 2 cases and pigmentation and peeling in 1 case in all patients in group A, the incidence of adverse reactions reached 8.0%. In all patients in group B, erythema and peeling occurred in 3 cases and pigmentation in 2 cases, which directly led to the occurrence of adverse reactions increased to 16.0%. According to statistical analysis, the frequency of adverse reactions in group B was significantly higher than that in group A, and there were differences in their statistical significance. Combined with the above data analysis, the risk of various adverse reactions after radiotherapy in group A is much lower than that in group B.

## 4. Discussion

In practice, studies and observations have shown that even if a patient has undergone breast conserving surgery for early stage breast cancer, adjuvant therapy, especially postoperative radiotherapy, is still needed. This is because although breast preservation surgery for early breast cancer can preserve most of the breast tissue, there is still the possibility that small lesions or hidden lesions are not completely removed. These residual lesions may continue to grow and spread for some time after surgery, eventually leading to a recurrence of the disease or the emergence of new breast cancer lesions. Postoperative radiotherapy is one of the key treatment measures, by using radiation to irradiate the breast area, remove residual lesions and inhibit the growth and spread of cancer cells. It can reduce the likelihood of recurrence of the disease and improve the survival and cure rate of patients. Postoperative radiotherapy is usually performed using techniques such as external radiotherapy or accelerator radiotherapy, and the specific program is individually designed according to the specific conditions and pathological characteristics of the patient. The study further showed that patients in group A who received intensity modulated radiotherapy of 60Gy had a more uniform dose distribution in the breast target area. This method of radiotherapy helps to reduce damage to otherwise normal tissues, as IMRT can reduce the proportion of volume occupied by high prescription doses in the target area. At the same time, the incidence of adverse reactions in group A was lower than that in group B, and the difference was statistically significant. These findings suggest the importance of choosing the right dose of radiation when using IMRT.

## 5. Conclusion

In summary, for patients with breast conserving surgery for early breast cancer, the application of intensity modulated radiation therapy with a total dose of 60Gy shows more obvious therapeutic effect and can reduce the incidence of adverse reactions. This study provides important guidance and basis for the treatment of early breast cancer patients.

## References


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