The clinical value of adjuvant radiotherapy in patients with early stage breast cancer with 1 to 3 positive lymph nodes after mastectomy

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[Abstract] Background and Objective: The role of postmastectomy radiotherapy (PMRT) in breast cancer patients with T1–T2 tumors and 1–3 positive axillary nodes is still uncertain. This study investigated the value of PMRT for these patients. Methods: In the retrospective data of 488 eligible patients, survival analysis was performed using the Kaplan-Meier method. Univariate and multivariate analyses were performed using a log-rank test and the Cox proportional hazards model, respectively. Results: The median observation time was 54 months. The 5- and 10-year locoregional recurrence-free survival (LRFS) rates were 90.8% and 86.9%, respectively. The 5- and 10-year disease-free survival (DFS) rates were 82.0% and 74.3%, respectively. The 5- and 10-year overall survival (OS) rates were 90.7% and 82.7%, respectively. For the 412 patients without PMRT, T2 classification, 2–3 positive nodes, and hormone (estrogen and progesterone) receptor-negative were risk factors for locoregional recurrence in the multivariate analysis. On the basis of these 3 risk factors, the group with 2–3 factors had a 10-year LRFS rate of 63.1% compared with 96.1% for the group with 0–1 factors (P < 0.001). For the group with 2–3 risk factors, LRFS and DFS were significantly improved by PMRT, with the 5- and 10-year LRFS rates without PMRT of 82.4% and 63.1%, respectively, and, with PMRT, of 98.1% at both 5 years and 10 years (P = 0.002). The 5- and 10-year DFS rates without PMRT were 72.0% and 57.6%, respectively, and, with PMRT, the 5- and 10-year DFS rates were 89.4% and 81.7%, respectively (P = 0.007). There was no significant difference in the 10-year OS rates between patients with and without PMRT. However, there is the potential benefit of 15.3% (87.1% vs. 71.8%, P = 0.072). Conversely, the group with 0–1 factors of PMRT had no effect on prognosis. Conclusions: In patients receiving mastectomy with T1–T2 breast cancer with 1–3 positive nodes, for the group with 2–3 risk factors, PMRT significantly improved LRFS and DFS and has potential benefit in OS.

Key words: Breast neoplasms, surgery, radiotherapy, prognosis

For patients with primary breast cancer having a diameter of > 5 cm, ≥ 4 positive axillary lymph nodes, or both, there is already a general consensus that adjuvant radiotherapy to the chest wall and lymph node drainage pathways after mastectomy, and standard chemotherapy could improve the local control rate, hence improve the rate of overall survival (OS). However, for patients with primary tumors having diameters ≤ 5 cm (stage T1–T2) accompanied with 1–3 positive axillary lymph nodes, the value of adjuvant postmastectomy radiotherapy (PMRT) has been the focus of controversy in recent years.

In the practice guidelines of breast cancer of National Comprehensive Cancer Network (NCCN) between 2008–2010, it has changed from former “consider” to “strongly consider” to deliver radiotherapy to the chest wall and supraclavicular area for patients with 1–3 positive axillary lymph nodes. However, at the St. Gallen breast cancer meeting in 2009, for the majority of the specialists, routine adjuvant PMRT was not recommend, and PMRT was only considered when patients were young or had a
poor prognosis \[3\]. The focus of debate consisted of the survival benefit brought about by the improvement of surgical techniques as well as the progress of adjuvant therapy, prophylactic radiation targeting, and the late complications of adjuvant radiotherapy\[4,5\]. Nevertheless, for patients with 1–3 positive axillary lymph nodes, the survival problems caused by locoregional recurrence (LRR) allows for no negligence. As a result, if further subgroup analysis was conducted to predict prognosis and to instruct treatment strategies, part of the subgroups with high rates of LRR could possibly achieve a survival benefit.

The present study analyzes the prognostic factors that influence LRR, researches the clinical value of adjuvant PMRT, and seeks proper subgroups for adjuvant radiotherapy by retrospectively analyzing the clinical data of 488 patients with stage T1–T2 disease and 1–3 positive axillary lymph nodes who have received mastectomy.

**Materials and Methods**

**Selection criteria**

The clinical data of 488 patients with 1–3 positive axillary lymph nodes enrolled at the Sun Yat-sen University Cancer Center between January 1998 and May 2007 were collected and analyzed. Among them, 76 patients received adjuvant PMRT and 412 did not. Case selection criteria was as follows: (1) woman with unilateral breast cancer and receiving mastectomy; (2) primary tumor and axillary lymph nodes staging T1–T2N1M0 (stage II) according to the International Union Against Cancer/American Joint Committee on Cancer (UICC/AJCC) 2002 staging criteria; (3) negative pathology incision margin for the primary tumor and no extracapsular invasion for axillary lymph nodes; (4) no neoadjuvant treatment was delivered before the procedure; (5) patients of any age could be enrolled, and at least 4 courses of adjuvant postoperative chemotherapy should be delivered for patients < 70 years; (6) no severe accompanying disease.

**Common data**

In total, 488 patients met the selection criteria, and the clinical data of the whole group is detailed in Table 1. Median age was 47 years (range: 23–81 years), with 322 patients premenopausal and 166 postmenopausal. A total of 133 patients had stage T1 disease and 355 patients had stage T2 disease. Primary tumors were located at the outer quadrant in 348 patients, the inner quadrant in 76 patients, the central region in 61 patients, and unknown in 3 patients. The pathology diagnosis was infiltrating duct carcinoma (452 patients), infiltrating lobular carcinoma (12), medullary carcinoma (6), solid-endocrine carcinoma (5), mucinous adenocarcinoma (5), mixed carcinoma (5), and other (3). In the pathology reports of 19 patients, vascular invasion was indicated. The status of axillary lymph nodes were 247, 126, and 115 patients with 1, 2, or 3 positive lymph nodes, respectively. In patients without adjuvant radiotherapy, the median number of axillary lymph nodes in excised was 14 (range 4–42). In patients receiving adjuvant radiotherapy, the median number of axillary lymph nodes excised was 10 (range 3–24). Regarding the immunohistochemistry status, there were 304 patients with positive estrogen receptor (ER), 323 patients with positive progesterone receptor (PR), 352 patients with positive ER and/or PR, 117 patients with negative ER and PR, and no details on ER or PR for 19 patients. There were 156 patients with positive Her2 (at least 2+ in immunohistochemistry tests), 283 patients with negative Her2, and the Her2 status was unknown in 49 patients.

**Treatment**

All enrolled patients received mastectomy after the diagnosis was proved on pathology. Adjuvant postoperative chemotherapy was delivered to 481 patients, with the median number of chemotherapy courses at 6 (range 4–9 courses), and the chemotherapy regimen of CEF/CAF (cyclophosphamide, epirubicin/adriamycin, fluorouracil) was prescribed to 353 patients, the CMF regimen (cyclophosphamide, methotrexate, fluorouracil) was prescribed to 45 patients, and the TA regimen (paclitaxel, adriamycin) was prescribed to 83 patients. For 7 patients ≥ 70 years and positive for hormone receptors, endocrine therapy alone was prescribed. Endocrine therapy was delivered to 363 patients with positive ER and/or PR, 11 patients with negative ER and PR also received endocrine therapy with the median medication time at 54 months (range 20–75 months), mainly by antiestrogens and aromatase inhibitors.

Adjuvant radiotherapy was delivered to 76 patients within 6 months after surgery. Treatment targets covered the ipsolateral chest wall and the supraclavicular area at the least, including the axilla covered in 3 patients and internal mammary nodes covered in 2 patients. In chest wall radiation, 6–9 MeV electron beams \((n = 69)\) or 6–8 MV X-ray tangential fields \((n = 7)\) were used, and to irradiate the supraclavicular area, the combination radiation of 6–8 MV X-rays and 10–12 MeV electron beams was used. The total radiation dose was 46–50 Gy.

**Method and content of follow-up**

All patients returned to visit the outpatient department or were followed by telephone. The first day after surgery was
taken as the start date of follow-up, and patients enrolled were followed until May 2009. The rates of locoregional recurrence-free survival (LRFS) (locoregional recurrence +/- distant metastasis), disease-free survival (DFS), and overall survival (OS) were taken as endpoints of the present study. Locoregional recurrence refers to relapse focused in the ipsolateral chest wall, the lymph nodes in the supraclavicular or infraclavicular area, axillary lymph nodes, or internal mammary lymph nodes, and recurrent lesions should be pathologically proven on biopsy.

### Statistical methods

SPSS version 16.0 was used to establish the database. The Kaplan-Meier method was adopted to calculate survival rates. A log-rank test was used to conduct the significant differences among groups.
differences test. The Cox proportional hazards model was taken in multivariate analysis with \( P < 0.05 \) defined to have statistical significance. The rest of the analyses were conducted by \( \chi^2 \) test.

_results_

Survival and disease progression status of the patients

The median follow-up time for the entire 488 patients was 54 months (range 8–136 months). The 5- and 10-year LRFS rates for the whole group were 90.8% and 86.9%, respectively. The 5- and 10-year DFS rates were 82.0% and 74.3%, respectively. The 5- and 10-year OS rates were 90.7% and 82.7%, respectively. There were 45 deaths, including 43 patients dying of breast cancer and 2 patients of other diseases. A total of 43 locoregional recurrences were observed in 43 patients, with the median relapse time at 26 months (range 1–63 months). In patients without adjuvant radiotherapy, 42 recurrences (42/412 patients, 10.2%) occurred, including 20 (20/42, 47.6%) in the supraclavicular area, 12 (12/42, 28.5%) in the chest wall, 5 (5/42, 11.9%) in \( \geq 2 \) sites, 2 (2/42, 4.8%) in the axilla, 2 (2/42, 4.8%) in the infracavicular area, and 1 (1/42, 2.4%) in the internal mammary area. Among patients receiving adjuvant PMRT, only 1 patient (1/76, 1.3%) had recurrence in the axilla and the supraclavicular area. Of all patients, 60 patients developed distant metastasis, and the 5- and 10-year DFS rates were 87.7% and 77.1%, respectively. Bone (33.3%), lung (25.0%), and liver (21.7%) were the most common metastatic sites. Among the patients with LRR, 15 patients had distant metastasis (15/43, 34.9%), and the median time to relapse was 11 months (range 4–75 months).

Prognostic factors that influenced LRFS

Results of the univariate analysis on the clinical data of the entire group indicated that stage T2, 2–3 positive axillary lymph nodes, negative hormone receptor (negative ER and PR), no endocrine therapy delivered, and no PMRT were prognostic factors that influenced LRFS. Age, menstruation status, location of tumor mass, pathology type, Her2 expression, total amount of the excised lymph nodes, and ratio of positive nodes (PN) exerted no impact on LRFS (Table 1). Results of the univariate analysis on the 412 patients without adjuvant radiotherapy indicated that stage T2, 2–3 positive axillary lymph nodes, negative hormone receptor, positive Her2 expression, ratio of PN > 25%, and no endocrine therapy delivered were poor prognostic factors that influenced the LRFS of patients without PMRT (Table 1). The results of the Cox analysis showed that stage T2, 2–3 positive axillary lymph nodes, and negative hormone receptors were independent prognostic factors that impacted the LRFS of patients without PMRT (Table 2), and the 10-year LRFS of these 3 independent prognostic risk factors were 83.9%, 86.0%, and 68.4%, respectively. After grouping according to the 3 independent prognostic factors mentioned above, the results suggested that the 5-year LRFS rates for patients with 0, 1, 2, and 3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 0–1 prognostic factors were both 96.1%, whereas the 5- and 10-year LRFS rates for patients with 2–3 prog...
Influence of adjuvant radiotherapy on prognosis

Locoregional recurrence-free survival rate PMRT has significantly improved LRFS, with the 5- and 10-year LRFS rates to be both 98.7%, while the 5- and 10-year LRFS rates for patients without PMRT was only 89.3% and 81.4%, respectively ($\chi^2 = 7.486$, $P = 0.006$) (Figure 1). The treatment benefit for patients in the high-risk group was more significant, with 5- and 10-year LRFS rates for PMRT to be both 98.1%, while the 5- and 10-year LRFS rates for patients without PMRT were only 82.4% and 63.1%, respectively ($\chi^2 = 9.654$, $P = 0.002$) (Figure 2). For patients in the low-risk group, no influence of PMRT was found on LRFS, with the 5- and 10-year LRFS rates both at 100%, while the 5- and 10-year LRFS rates for patients without PMRT was both 96.1% ($\chi^2 = 0.880$, $P = 0.349$) (Figure 3).

Disease-free survival rate PMRT also significantly improved DFS, with the 5- and 10-year DFS rates at 91.2% and 82.3%, respectively, while for patients without PMRT, the 5- and 10-year DFS rates were only 80.3% and 73.4%, respectively ($\chi^2 = 4.134$, $P = 0.042$) (Figure 4). The treatment benefit for patients in the high-risk group was more significant, with 5- and 10-year DFS rates of PMRT to be 89.4% and 81.7%, respectively, while for patients...
without PMRT, the 5- and 10-year DFS rates were only 72.0% and 57.6%, respectively ($\chi^2 = 7.315, P = 0.007$) (Figure 5). For patients in the low-risk group, no influence of PMRT was found on DFS, with the 5- and 10-year DFS rates at 95.5% and 83.5%, respectively, while for patients without PMRT, the 5- and 10-year DFS rates were only 89.0% and 87.3%, respectively ($\chi^2 = 0.242, P = 0.622$) (Figure 6).

For patients in the high-risk group, the impact of PMRT on DFS was significant ($\chi^2 = 7.315, P = 0.007$) (Figure 5). For patients in the low-risk group, no influence of PMRT was found on DFS, with the 5- and 10-year DFS rates at 95.5% and 83.5%, respectively, while for patients without PMRT, the 5- and 10-year DFS rates were only 89.0% and 87.3%, respectively ($\chi^2 = 0.242, P = 0.622$) (Figure 6).

No statistical difference was found in the influence of PMRT on OS. However, there were potential survival benefits, with the 5- and 10-year OS to be 93.8% and 87.7%, respectively, while for patients without PMRT, the 5- and 10-year OS rates were only 90.0% and 81.3%, respectively ($\chi^2 = 1.316, P = 0.251$) (Figure 7). The potential benefit for patients in the high-risk group was more significant, with the potential benefit on 5- and 10-year OS rates of PMRT to be 9.1% (95.9% vs. 86.8%) and 15.3% (87.1% vs. 71.8%), respectively ($\chi^2 = 3.232, P = 0.072$) (Figure 8). For patients in the low-risk group, no overall survival benefit of PMRT was found, with the 5- and 10-year OS rates both at 89.3%, while for patients without PMRT, the 5- and 10-year OS rates were 93.5% and 90.3%, respectively ($\chi^2 = 0.076, P = 0.782$) (Figure 9).

**Overall survival rate** No statistical difference was found in the influence of PMRT on OS. However, there were potential survival benefits, with the 5- and 10-year OS to be 93.8% and 87.7%, respectively, while for patients without PMRT, the 5- and 10-year OS rates were only 90.0% and 81.3%, respectively ($\chi^2 = 1.316, P = 0.251$) (Figure 7). The potential benefit for patients in the high-risk group was more significant, with the potential benefit on 5- and 10-year OS rates of PMRT to be 9.1% (95.9% vs. 86.8%) and 15.3% (87.1% vs. 71.8%), respectively ($\chi^2 = 3.232, P = 0.072$) (Figure 8). For patients in the low-risk group, no overall survival benefit of PMRT was found, with the 5- and 10-year OS rates both at 89.3%, while for patients without PMRT, the 5- and 10-year OS rates were 93.5% and 90.3%, respectively ($\chi^2 = 0.076, P = 0.782$) (Figure 9).

**Figure 5** Impact of adjuvant radiotherapy on disease-free survival in high-risk patients

**Figure 6** Impact of adjuvant radiotherapy on disease-free survival in low-risk patients

**Figure 7** Impact of adjuvant radiotherapy on overall survival for the entire cohort

**Figure 8** Impact of adjuvant radiotherapy on overall survival in high-risk patients

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Figure 9 Impact of adjuvant radiotherapy on overall survival in low-risk patients

Discussion

For patients who received mastectomy with 1–3 positive axillary lymph nodes, LRR rates were around 8%–27%. Various levels of surgery, the excised extent of axillary lymph nodes, and the difference of postoperative adjuvant therapy could lead to a variety of LRR rates. As documented, one of the most common postoperative relapse sites for patients with 1–3 positive axillary lymph nodes was the chest wall, and the recurrence in the supraclavicular fossa was rare. Macdonald et al. pointed out that irradiation to the chest wall alone and irradiation to the chest wall as well as the supraclavicular area simultaneously could achieve the same treatment benefit. The ongoing randomized control trial SUPREMO (Selective Use of Postoperative Radiotherapy after Mastectomy) also made the chest wall the main radiation site, and regional lymph nodes was the optional radiation area.

However, in the present study, the supraclavicular fossa was the most common site for recurrence (47.6%), followed by the chest wall (28.5%). Wang et al. indicated that the supraclavicular area (42.9%) and chest wall (40.4%) were both the most common recurrence sites. The probability of distant dissemination significantly increased when LRR occurred, and the prognosis of supraclavicular fossa relapse was especially worse than chest wall and axillary relapse. As a result, if adjuvant radiotherapy was proposed for patients who had received mastectomy with 1–3 positive axillary lymph nodes, the target volume should include at least the ipsilateral chest wall and the supraclavicular area, and the continuing spread of locoregional residual focus could be prevented by improving local control rates, and hence achieve a survival benefit.

Nevertheless, the application value of PMRT still depends on whether the benefit on local control and OS could exceed the incidence and mortality of treatment-related complications. Late complications after radiotherapy, especially late cardiovascular complications, were the main cause that led to the increase of mortality not related to breast cancer, and this was probably the major reason that there is presently still no consensus on postoperative adjuvant radiotherapy for patients with 1–3 positive axillary lymph nodes. Along with the improvement of modern radiotherapy equipment and techniques, together with the recognition of target volumes in radiotherapy, damage to the cardiovascular system by modern radiotherapy could be further alleviated.

In recent years, more and more documents and reports have confirmed the effect of PMRT for patients with 1–3 positive axillary lymph nodes. According to a retrospective study by the European Organization for Research and Treatment of Cancer (EORTC), relative to patients with more than 4 positive axillary lymph nodes, PMRT for those with 1–3 positive axillary lymph nodes could reflect more survival benefit. A study by the Danish Breast Cancer Cooperative Group (DBCG) showed that PMRT for patients with more than 4 positive axillary lymph nodes and 1–3 positive lymph nodes could bring down the 15-year local recurrence rate by 41% and 23%, respectively, while PMRT could benefit to 15-year OS rates, both increasing by 9%.

Wang et al. indicated that although PMRT exerted no influence on 5-year OS rates (86.7% vs. 85.2%, \( P = 0.620 \)), it could significantly improve 5-year LRFS rates (100% vs. 89.5%, \( P = 0.023 \)). The present study suggested that PMRT could significantly improve local control rates, and hence improve DFS, and the trend existed that OS could also be improved, however, there was no statistical difference (10-year 87.7% vs. 81.3%, \( P = 0.251 \)). These would possibly be related to the following reasons: (1) in the studies by the EORTC and DBCG, the chemotherapy regimen was CMF-based, however, in the present study and the study by Wang et al., the chemotherapy regimen was mainly anthracycline- or Taxane-based. It was already confirmed that the 2 chemotherapy regimens mentioned above could yield more significant benefits on survival than the CMF regimen, so the great effect of PMRT for our patients manifested in the improvement of local control rates; (2) in the study by the EORTC (median follow-up time 6.1–13.4 years) and the DBCG, the follow-up time was longer, which inflected the survival benefit of PMRT. British Columbia randomized trial suggested that the survival when followed for 20 years was higher than when followed for 15 years, which indicated that along with the extension of time, the benefit of radiotherapy on survival further increased.

Longer follow-up in the...
future is needed for the patients in the present study. To sum up, for patients with 1–3 positive axillary lymph nodes, PMRT could significantly improve the local control rate. In addition, although it has exerted different influence on OS, there was a trend that OS tended to be improved. Nevertheless, Whelan et al.\(^{[17]}\) held the opinion that for patients with 1–3 positive axillary lymph nodes, the value of PMRT still depended on further subgroup analysis and category I evidence. It was believed that the results of the SUPREMO\(^{[15]}\) randomized control trial, which was based on the present adjuvant therapy, could offer helpful reference to the value of PMRT. However, this trial is ongoing, and it still has a long time till the publication of its results.

As a result of the development of systemic treatment, including anthracyclines, Taxane, aromatase inhibitors, and Trastuzumab, LRR rates could be further brought down by biomarker detection and the selection of corresponding drugs for adjuvant therapy\(^{[4]}\). Woodward et al.\(^{[18]}\) pointed out that for patients with 1–3 positive axillary lymph nodes, the 10-year LRR rate was still up to 13% with systemic chemotherapy based on anthracyclines, whereas that for patients receiving adjuvant radiotherapy was only 3%. In the present study, 91% of the patients without adjuvant radiotherapy received systemic treatment containing anthracyclines or Taxane, and the 10-year LRR rate was as high as 18.6%. For patients whose 10-year LRR rate was less than 10%, radiotherapy could be omitted because of the slight benefit of PMRT. For those whose 10-year LRR rate was more than 25%, PMRT could help to improve local control rates, and hence bring about a survival benefit. For those whose 10-year LRR rate was between 10%–25%, decisions should be made after weighing the pros and cons\(^{[9]}\).

In this regard, taking the point of view of the St. Gallen breast cancer meeting that PMRT could be considered for patients with poor prognosis, could we select subgroups with high-risk factors for recurrence within patients whose LRR rate was between 10% and 25% for adjuvant radiotherapy, try to improve local control rates, and translate it into improvements of survival? This assumption has already gained the support of a certain studies. Yang et al.\(^{[20]}\) showed that for patients with negative ER and vascular invasion, adjuvant PMRT could significantly reduce the LRR rate (40% vs. 12.5%, \(P = 0.038\)), and the 5-year OS rate was also elevated from 43.7% to 87.1% (\(P < 0.001\)). Fodor et al.\(^{[21]}\) indicated that for patients with stage T2 disease, 15-year isolated LRR rate of PMRT decreased from 30% to 10% (\(P = 0.0244\)), and the 15-year DFS rates increased from 32% to 50% (\(P = 0.1213\)). Results of the present study suggested that for patients with 2–3 risk factors that influenced LRR (stage T2, 2–3 positive axillary lymph nodes, negative hormone receptors), the 5-year LRR rate could be as high as 36.9%. For those with 2–3 risk factors, the treatment benefit of PMRT on local control and DFS rates further increased. Although no statistical difference was found on its influence on OS, a stronger benefit trend was reflected (10-year OS 87.1% vs. 71.8%, \(P = 0.072\)). For patients with 0–1 risk factor, PMRT failed to show any treatment benefit in the present study. As a consequence, according to the results of the present study, it is feasible to establish a grouping mode to predict the subgroups with high risks for LRR, and hence instruct our treatment. However, due to the few reports at present on multivariate combined analysis, further research is needed.

In conclusion, based on the results of the present study, when no consensus has been achieved on adjuvant radiotherapy for patients who have received mastectomy with stage T1–T2 disease and 1–3 positive axillary lymph nodes, we suggest postoperative adjuvant radiotherapy to the chest wall and the supraclavicular area for patients with 2–3 risk factors that influence LRR (stage T2, 2–3 positive axillary lymph nodes, negative hormone receptors).

### Reference


