

Is breast conservative surgery a reasonable option in multifocal or multicentric tumors?

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Abstract

The incidence of multifocal (MF) and multicentric (MC) carcinomas varies widely among clinical studies, depend-

ing on definitions and methods for pathological sampling. Magnetic resonance imaging is increasingly used because it can help identify additional and conventionally occult tumors with high sensitivity. However, false positive lesions might incorrectly influence treatment decisions. Therefore, preoperative biopsies must be performed to avoid unnecessary surgery. Most studies have shown higher lymph node involvement rates in MF/MC tumors than in unifocal tumors. However, the rate of local recurrences is usually low after breast conservative treatment (BCT) of MC/MF tumors. It has been suggested that BCT is a reasonable option for MC/MF tumors in women aged 50-69 years, with small tumors and absence of extensive ductal carcinoma *in situ*. A meta-analysis showed an apparent decreased overall survival in MC/MF tumors but data are controversial. Surgery should achieve both acceptable cosmetic results and negative margins, which requires thorough preoperative radiological workup and localization of lesions. Boost radiotherapy techniques must be evaluated since double boosts might result in increased toxicity, namely fibrosis. In conclusion, BCT is feasible in selected patients with MC/MF but the choice of surgery must be discussed in a multidisciplinary team comprising at least radiologists, surgeons and radiotherapists.

Key words: Mastectomy; Breast conservative surgery; Multifocal tumors; Multicentric tumors; Radiotherapy; Local recurrence; Breast cancer; Survival

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Core tip: Multicentric and multifocal breast tumors should be identified preoperatively in order to adapt surgical treatment. They might be associated with more frequent lymph node involvement and worse prognosis but in most studies, the rates of local recurrence are low and similar to those of unifocal tumors. Breast conservative treatment is a reasonable option in selected patients

(age 50-69 years, small tumors and absence of extensive ductal carcinoma *in situ*). Postoperative radiotherapy, and especially boost radiotherapy must be discussed and evaluated due to the risk of increased toxicity in case of double boost.

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INTRODUCTION

Multicentric (MC: At least 2 invasive tumors in 2 different quadrants) or multifocal (MF: At least 2 invasive tumors in the same quadrant) carcinoma can be diagnosed preoperatively or in resected specimens^[1,2]. The frequency of these tumors ranges from 4% to 75%^[3-10]. This large variability results from differences in the definitions used and the methods of pathologic sampling^[11,12]. With continuous advances in preoperative imaging, the rate of MF and MC tumors is increasing^[13-15].

Conservative surgery with radiotherapy has been widely accepted as an alternative to mastectomy in the management of early stage breast cancer^[16,17], with a long-term local recurrence rate of approximately 15%-20%^[16-28]. The diagnosis of multifocality may influence breast cancer management, particularly with regard to the choice of surgery. Conservative treatment as an alternative to mastectomy in patients with synchronous ipsilateral breast cancer is controversial and no consensus exists. MF/MC breast cancer is generally considered as a contraindication for conservative surgery because of concerns about an increased risk of local recurrence^[29-32]. According to some reports, the local recurrence rate in MF/MC breast cancer after breast conservative therapy (BCT) is higher than that of unifocal tumors^[31,33]. This is the main reason for excluding BCT for MF/MC breast cancer^[34]. Moreover, poor cosmetic results, due to large resections, are also evoked. Therefore, many surgeons continue to perform mastectomy in patients with MF/MC breast cancer.

In contrast, extensive data have confirmed an excellent local control after BCT for unifocal breast cancer^[16,17,35-43]. At the 12-year follow-up of the National Surgical Adjuvant Breast and Bowel Project B-06 trial, the cumulative incidence of ipsilateral breast recurrence was only 10% in the group treated by lumpectomy and breast irradiation^[36].

The effectiveness of boost radiation treatment to decrease local recurrence has been established in a randomized trial by Bartelink *et al.*^[44]. However, in MF/MC breast cancer, the influence of boost radiation has been poorly reported. From a surgical point of view, BCT with negative margins and acceptable aesthetic outcome

can be achieved if tumour foci are close enough to be resected as a single specimen^[45].

One study has shown a significant association between positive surgical margins and failure of attempted BCT in the case of MF tumors^[46].

This review will focus on the issue of conservative surgery with radiotherapy in the management of patients with MF/MC breast cancer.

DEFINITION OF MF AND MC TUMORS

MC carcinomas are defined by the presence of at least two invasive tumors in two different quadrants of the breast or in the same quadrant but at least 5 cm apart^[1]. MF carcinomas are defined by the presence of several invasive tumors in the same quadrant of the breast or in different quadrants if the distance between foci is below 5 cm.

Multiple tumors are defined by the presence of synchronous, distinct, invasive tumors in the same breast, and comprise MC and MF carcinomas. They can be discovered in two different settings: (1) Preoperative diagnosis of at least 2 different invasive tumors, based on clinical and/or radiological findings; and (2) Histological diagnosis when pathological examination of surgical specimens shows several foci, while the tumor was considered as unifocal based on preoperative workup.

However, various situations must be considered according to the localization of multiple tumors in the different quadrants of the breast and to the distance from the nipple-areola complex^[47].

FREQUENCY OF MC AND MF TUMORS

In the meta-analysis published by Vera-Badillo *et al.*^[3], including 67557 patients, the rate of MC/MF tumors was 9.5% (6434 patients). In the EORTC 10981-22023 AMAROS trial, MF tumors of the same quadrant were included after 2008 and represented 33% of cases (342/1026)^[4].

However, the prevalence of MC/MF tumors varies from 5% to 44% in published series^[4-8], depending on the definition used, the method of histological examination of mastectomy specimens and the type of imaging used for diagnosis (Table 1).

Imaging

Mammography and ultrasound are the standard imaging tests for the diagnosis of breast cancer, and are also used to determine the extent of the disease within the affected breast. Because of its high sensitivity in breast cancer diagnosis and screening, magnetic resonance imaging (MRI) is being increasingly evaluated and used for preoperative local staging of breast cancer. Several multicenter trials showed that, in women with newly diagnosed breast cancer, MRI helped identify additional, conventionally occult lesions in 15%-27% of cases^[48-51]. In addition, MR helped identify unsuspected synchronous cancer in the opposite breast in 3%-6%

Table 1 Incidence of multifocal/multicentric tumors in the literature

Ref.	Yr	MF/MC (n)	MF/MC (%)
NIH <i>et al</i> ^[81]	1986	342	9
Vlastos <i>et al</i> ^[82]	2000	60	21
¹ Katz <i>et al</i> ^[83]	2001	149	14
Andea <i>et al</i> ^[62]	2002	101	18
¹ Pedersen <i>et al</i> ^[84]	2004	158	17
EBCTCG ^[85]	2005	1187	6
Coombs <i>et al</i> ^[8]	2005	94	11
¹ Litton <i>et al</i> ^[86]	2007	58	19
¹ Joergensen <i>et al</i> ^[87]	2008	945	13
¹ Cabioglu <i>et al</i> ^[88]	2009	147	11
¹ Yerushalmi <i>et al</i> ^[11]	2009	1554	6.1
¹ Weissenbacher <i>et al</i> ^[65]	2010	288	5
¹ Tot <i>et al</i> ^[89]	2011	148	30
Tot <i>et al</i> ^[90]	2011	225	44
Rezo <i>et al</i> ^[91]	2011	141	17
¹ Ustaalioglu <i>et al</i> ^[2]	2012	107	15.4
¹ Lynch <i>et al</i> ^[63]	2012	942	24
¹ Yerushalmi <i>et al</i> ^[5]	2012	1187	6
¹ Chung <i>et al</i> ^[66]	2012	164	14
Meretoja <i>et al</i> ^[92]	2012	206	20.6
¹ Pekar <i>et al</i> ^[93]	2013	153	34
Wolters <i>et al</i> ^[64]	2013	1862	20.8
Lynch <i>et al</i> ^[63]	2013	906	24
Hilton <i>et al</i> ^[94]	2013	202	15
van der Heiden-van der Loo <i>et al</i> ^[95]	2013	1729	13.1
Vera-Badillo <i>et al</i> ^[3]	2014	6565	9.7

¹Included in the meta-analysis of Vera-Badillo *et al*^[3]. MF/MC: Multifocal/multicentric.

of women with a recent diagnosis of unilateral breast cancer^[51]. However, the impact of breast MRI on breast cancer management is debated, due to a large number of additional benign lesions that could be detected and incorrectly influence clinical decisions^[52,53]. Indeed, one of the major limitations of breast MRI is that false-positive enhancement may appear in benign lesions, resulting in a relatively low specificity^[49]. If additional suspicious findings are identified, preoperative biopsies must be performed to limit the number of unnecessary wider excisions or mastectomies^[54].

INCIDENCE OF LYMPH NODE INVOLVEMENT IN MC/MF TUMORS

Although the meta-analysis of Vera-Bardillo *et al*^[3] did not show differences in the rate of lymph node involvement, all the other studies demonstrated a higher rate in MC/MF tumors compared to unifocal tumors, with a mean difference of 10% to 20%.

The studies that reported lymph node detection showed the positivity of sentinel nodes in 42% to 59% of cases^[4,55-62]. The main hypothesis to explain this higher rate is that the global tumor volume, that includes all MC/MF tumors, is usually more important than that of unifocal tumors. However, in MC/MF carcinomas, tumor size is determined by the largest index lesion regardless of the number and size of other lesions, which does not take into account the cumulative tumor volume.

In the EORTC 10981-22023 AMAROS trial, sentinel node involvement for MF and unifocal tumors respectively was the following: Macrometastases 61% (105/171) and 57% (109/192) (NS), micrometastases 30% (52/171) and 29% (55/192) (NS), isolated tumor cells 8% (13/171) and 14% (27/192) ($P = 0.05$)^[4].

LOCAL RECURRENCE RATE OF MC/MF TUMORS COMPARED WITH UNIFOCAL TUMORS

The rate of local recurrences for MC/MF tumors in case of conservative treatment is low, except in the 3 oldest studies (Table 2), and similar to that observed after conservative treatment of unifocal tumors. As for unifocal tumors, this rate depends on selection criteria, particularly resection in negative margins, age over 35 or 40 years and tumor phenotype (hormone receptors and HER2 status).

LOCAL RECURRENCE RATES AND SURVIVAL IN MC/MF TUMORS COMPARED TO UNIFOCAL TUMORS BY TREATMENT STRATEGY (CONSERVATIVE OR NOT)

In the study by Lynch *et al*^[63], published in 2013, the rate of local recurrences was determined for unifocal tumors ($n = 2816$) and for MC ($n = 233$) or MF ($n = 673$) tumors according to treatment, namely 256 BCT, 466 mastectomies without radiotherapy and 184 mastectomies followed by radiotherapy (PMRT). After a median follow-up of 52 mo, the rate of locoregional control was 99%, 96% and 98% for MF, MC and unifocal tumors respectively ($P = 0.44$). Subgroup analyses showed similar results for the three treatment strategies (BCT, mastectomy without radiotherapy or PMRT). In multivariate analysis, multicentricity/multifocality was not associated with decreased locoregional control. The authors concluded that BCT was a valid option for MC/MF carcinomas of the breast and that the presence of MC/MF alone is not an indication of PMRT.

In the study by Yerushalmi *et al*^[5], local recurrence rate was determined after a median follow-up of 7.9 years and the authors compared the outcome of 11983 BCT (11683 unifocal tumors and 300 MC/MF tumors), and 7771 mastectomies (6884 unifocal tumors and 887 MC/MF tumors)^[5]. One fourth of MC/MF patients had BCT (300/1187). MC/MF patients who benefited from BCT were aged 50 to 69 years, they had no extensive ductal carcinoma *in situ* (DCIS) and they had smaller tumors. Cumulative local recurrence rate at 10 years was 1) for BCT 4.6% (95%CI: 4.1, 5) in unifocal tumors vs 5.5% (95%CI: 2.6, 9.9) in MC/MF tumors, $P = 0.76$, 2) for mastectomies 5.8% (95%CI: 5.2, 6.5) for unifocal tumors vs 6.5% (95%CI: 4.7, 8.7) in MC/MF tumors,

Table 2 Rates of local recurrence in multifocal/multicentric breast cancer^[5,31-33,63,66,68-73,93-96]

Ref.	Yr	Patients	MF or MC	Median follow-up (mo)	Local recurrences, %
Leopold <i>et al</i> ^[32]	1989	10	MF/MC	64	40
Kurtz <i>et al</i> ^[31]	1990	61	MF/MC	71	25
Wilson <i>et al</i> ^[33]	1993	13	MF	72	25
Hartsell <i>et al</i> ^[71]	1994	27	MC	53	3.7
Nos <i>et al</i> ^[72]	1999	56	MF	60	11
Cho <i>et al</i> ^[73]	2002	15	MF/MC	76	0
Kaplan <i>et al</i> ^[74]	2003	36	MF/MC	45	3
Okumura <i>et al</i> ^[75]	2004	34	MF/MC	58	0
Oh <i>et al</i> ^[96]	2006	97	MF/MC	66	6
Gentilini <i>et al</i> ^[76]	2008	476	MF/MC	73	5
Lim <i>et al</i> ^[97]	2009	147	MF	59	2
Bauman <i>et al</i> ^[98]	2010	22	MF/MC	42	4.5
Chung <i>et al</i> ^[66]	2012	164	MF	112	6.1
Yerushalmi <i>et al</i> ^[5]	2012	300	MF/MC	95	5.51
Lynch <i>et al</i> ^[63]	2013	256	MF	52	1.95
Kadioğlu <i>et al</i> ^[99]	2014	237	MF	46	5.2
Kadioğlu <i>et al</i> ^[99]	2014	36	MC	46	2

MF/MC: Multifocal/multicentric.

$P = 0.77$. In multivariate analysis, MC/MF was not significantly associated with recurrence or poor survival. In an additional matched analysis, recurrence rates were similar for MC/MF and unifocal tumors ($P = 0.6$). The authors concluded that BCT is a reasonable option in selected cases of MC/MF tumors, in particular in women aged 50-69 years, with small size tumors (< 1 cm) without extensive DCIS.

Wolters *et al*^[64] compared recurrence free survival and overall survival in 8935 patients with 7073 unifocal tumors (79.2%), 1398 MF tumors (15.6%) and 464 MC tumors (5.2%). They did not show any difference in RFS (1) in MF tumors (T1/T2 treated according to guidelines) for BCT ($n = 623$) vs mastectomy ($n = 319$): HR = 1.25, (95%CI: 0.83-1.88), $P = 0.284$, and (2) in MC tumors after adjustment on tumor size in case of negative margins, for BCT ($n = 60$) vs mastectomy ($n = 217$): HR = 1.19, (95%CI: 0.48-2.97), $P = 0.7$ and vs mastectomy + PMRT, HR = 1.23, (95%CI: 0.51-3.00), $P = 0.64$.

IMPACT OF MC/MF TUMORS ON SURVIVAL AND SYSTEMIC RISK COMPARED TO UNIFOCAL TUMORS, REGARDLESS OF TREATMENT (BCT OR MASTECTOMY)

In a study on 288 unifocal tumors matched with 288 MC/MF tumors the presence of MC/MF was significantly associated with decreased OS ($P = 0.016$), increased local recurrences ($P = 0.001$) and development of metastases ($P = 0.038$)^[65].

In the study by Wolters *et al*^[64], after adjustment on age, tumor size, grade and nodal status, no difference was shown in RFS or OS in patients who received adjuvant therapy according to guidelines in MC or MF tumors compared to unifocal tumors: (1) For MC carcinomas, no

difference in RFS [HR = 0.88, (95%CI: 0.67-1.16), $P = 0.35$] and in OS [HR = 1.08, (95%CI: 0.85-1.36), $P = 0.54$]; and (2) for MF carcinomas, no difference in RFS [HR = 1.05, (95%CI: 0.89-1.24), $P = 0.597$] and in OS [HR = 0.92, (95%CI: 0.78-1.08), $P = 0.28$].

In the meta-analysis of Vera-Badillo *et al*^[3], the impact on survival of MF/MC tumors was compared to that of unifocal tumors from 22 studies and 67557 patients (6565 MF/MC et 62326 unifocal tumors). In multivariate analysis, MC/MF tumors were associated with decreased OS (HR = 1.65, 95%CI: 1.07-2.52; $P = 0.02$), but the difference was not statistically significant in RFS (HR = 1.96, 95%CI: 0.94-4.12; $P = 0.07$). The authors concluded that MC/MF tumors seem to be associated with worse prognosis; however, the heterogeneity between studies did not allow an accurate determination of the real risk (one study alone, that differs from other studies, determined the shorter OS^[66]).

SURGICAL PROCEDURES AND COSMETIC RESULTS

In MC/MF carcinomas, the localization of tumors is of utmost importance to determine the type of resection allowing both favorable cosmetic results and negative margins. Types of incision and resections are determined according to the localization of tumors, the breast size, the degree of ptosis, the areola size and the distance from areola. In the last decade with the introduction of oncoplastic techniques, the surgical approach of MC tumors have changed. Oncoplastic techniques are therefore particularly adapted and valuable in this situation, achieving negative margins and a good cosmetic results better than conventional BCS; a schematic cartography of various possible situations and resection techniques^[47] and a classification quadrant per quadrant atlas for many oncoplastic surgical procedures were proposed^[67]. This strategy was applied to a consecutive series of 175

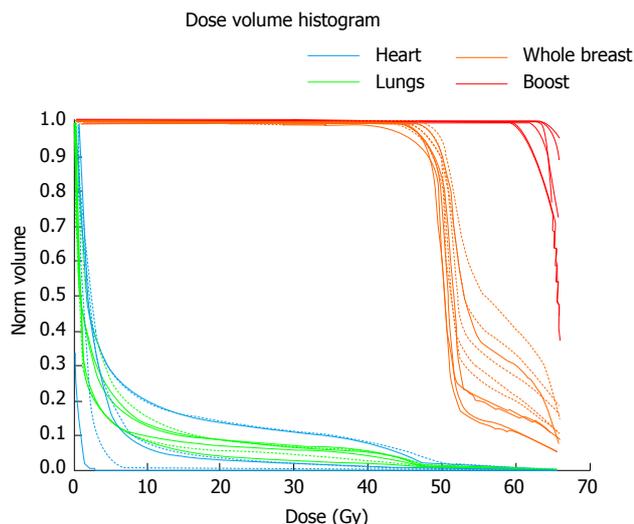


Figure 1 Dose-volume histograms for patients treated with a single boost (continuous lines) and with a double boost (dashed lines). The percentage of breast receiving 60 Gy or more with a single boost varies from 10% to 29% (median 15%, mean 16%) and with a double boost from 19% to 39% (median 25%, mean 27%).

women with breast cancer who required mastoplasty, including 27 patients (15.4%) with MF tumors^[68]. This study has confirmed that oncoplastic surgery techniques for breast cancer are associated with a low reoperation rate, a low risk of delay to adjuvant therapy and good cosmetic results. In another study, Clough *et al*^[69] reported 17.2% (10/58) of positive margins after oncoplastic surgery for MF breast cancer, without significant difference with positive margins rate after oncoplastic surgery for unifocal tumor (10.6%: 23/217).

Radiological workup and preoperative tracking are essential to perform appropriate resection with negative margins. The orientation and the identification of resection margins on surgical specimens, that sometimes have complex shapes and localizations, must be accurate and requires the collaboration of surgeons and pathologists. A completion resection might be necessary.

BOOST RADIOTHERAPY IN MF/MC TUMORS

The benefits of a boost to the tumor bed have been demonstrated for invasive breast cancer treated with conservative surgery. However, extended boost, and more specifically boost fields for two locations in the breast, should be thoroughly evaluated because of possible toxicity and side effects, particularly fibrosis^[70]. A preoperative consultation with radiotherapists should be proposed, if not recommended, when different boost fields are considered.

Fifteen studies have reported the outcomes of patients with multiple ipsilateral synchronous breast cancer treated with BCT followed by whole-breast irradiation (WBI)^[11,31-33,66,71-79]. Most of these studies included patients treated for MF disease rather than MC disease

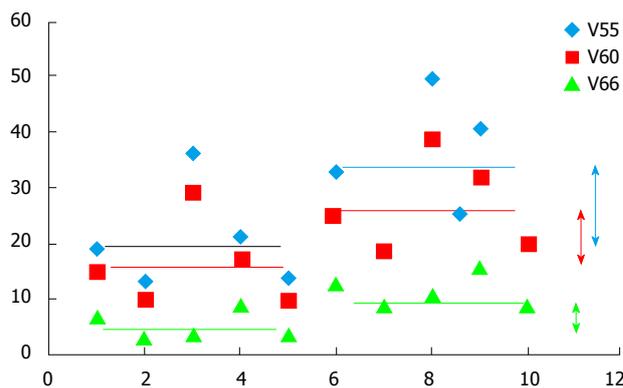


Figure 2 Volume of whole breast receiving an increased dose according to the dose-level. On the left side of the figure are reported the amount of breast receiving 66 Gy (green), 60 Gy (red) or 55 Gy (blue), in patients treated with a single boost (first 5 patients); on the right side of the figure are reported the amount of breast receiving 66 Gy, 60 Gy or 55 Gy, in patients treated with a double boost. The double arrows show the magnitude of increasing dose from single to double boost, according to dose level.

and the patients were mostly operated with a single incision and therefore a single field designed for the boost^[31-33,71,72]. BCT through double lumpectomy for MC disease raises the question of the safety of a double boost, regarding particularly the cosmetic result. Adding a boost after 50 Gy WBI increases the 10-year rate of severe fibrosis from 1.6% to 4.4% and of moderate fibrosis from 13% to 26%^[80]. Increasing the volume of the boost may increase this risk resulting in a poor cosmetic outcome, which is however the goal of BCT. This is the reason why we conducted a dosimetric study to assess the volume of breast receiving an increased dose, in patients treated in a classical manner (50 Gy-whole-breast + 16 Gy-single boost) and in patients treated with a double boost. The dose levels investigated were 110% and 120% of the prescribed dose (V55 and V60), and V66 as 66 Gy was the dose prescribed to each boost volume. Adding a second boost resulted in a 14%-increase of the volume of breast receiving more than 55 Gy, (from 19% to 33%), a 10%-increase of the volume of breast receiving more than 60 Gy, (from 15% to 25%) and a 2 Gy-increase in the mean dose received by the ipsilateral whole breast (Figures 1 and 2). The clinical significance of this increased dose is unknown but is expected to be real and deserves evaluation. An alternative could be an intraoperative boost, which would allow the preservation of the surrounding structures (normal tissues).

CONCLUSION

Conservative treatment is a reasonable option in selected cases of MF or MC tumors. Radiological workup and preoperative evaluation of all tumor sites are essential. A multidisciplinary discussion should be mandatory, especially for distant localizations, involving above all surgeons, radiologists and radiotherapists.

The selection of patients with low risk of recurrence

might be determined on the following criteria^[11,47,76]: (1) Technical feasibility, acceptable planned cosmetic result; (2) patient's choice after information about the risk of a new resection or mastectomy in cases of positive margins; (3) age > 40 years or > 50 years, absence of DCIS; (4) size of the largest lesion < 20 mm; and (5) feasibility of radiotherapy, including boost.

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