Mastectomy with immediate breast reconstruction: Results of a mono-centric 4-years cohort

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ABSTRACT

Introduction: Oncological safety, quality of life and cosmetic outcomes seems to be similar between breast conserving surgery (BCS) and mastectomy with immediate breast reconstruction (IBR). We report our experience of IBR for consecutive mastectomies realized in a recent period of four years in order to determined immediate surgical results according to type of mastectomy and type of reconstruction, as main objectives.

Methods: All mastectomies with IBR during years 2016–2019 were included. A retrospective analysis with prospective data collection was performed.

Results: We analyzed 748 IBR: 353 nipple-sparing mastectomies (NSM), 391 skin-sparing mastectomies (SSM) and 4 standard mastectomies, 551 with definitive implant or expanders and 196 with latissimus dorsi-flap (LDF). More NSM were performed during the 2 last years and more LDF were performed for high BMI, high breast cup-size, neo-adjuvant chemotherapy and radiotherapy and local recurrence. We realized 111 robotic NSM and 125 robotic LDF. Longer duration of surgery was significantly associated with the robotic procedures. The overall complications crude rate was 31.4% with 9.9% of re-operations and 5.8% of implant loss. Grade 2–3 complications were significantly associated with smoking. Breast complications occurred in 32.9% of mastectomy with principally skin or nipple-areola-complex suffering or necrosis, hematomas and infections. A predictive score was determined to evaluate risk of complications before surgery.

Conclusion: Mastectomy with IBR seems to be a safe technique with an acceptable complication rate which is increased by tobacco use, high breast cup-size and IBR-type.

1. Introduction

Breast-conserving surgery (BCS) for breast cancer (BC) has increase since numerous years and with recentment of development on oncoplasty and re-operation only for non in-sano resection. However total mastectomies for BC were still required in 12%–30% of patients [1–3]. Mastectomies can be required for extended ductal carcinoma in-situ (DCIS), multifocal disease, large BC according to breast size without indication of neo-adjuvant chemotherapy (NAC), prophylactic mastectomies, ipsilateral BC local recurrence (ILBCLR), non in-sano initial resection and patient’s wishes. Secondary mastectomy for non in-sano BCS was realized in 40.8%–58.4% [4].

In France, immediate breast reconstruction (IBR) rate was lower than others European countries but has been increasing for several years [5]. Until now, IBR indications were: extended or multifocal DCIS, ILBCLR and prophylactic mastectomy [6] but was discussed for BC requiring adjuvant chemotherapy or radiotherapy [7].

In a recent French prospective study, satisfaction with the cosmetic outcome strongly influenced quality of life and an unsatisfactory outcome after IBR was still considered a better condition than simple mastectomy [8]. In the US, variable rates of breast reconstruction were reported, depending a great deal on where patients lived, what kind of health insurance they had and her race/ethnicity [9].

Reconstruction with implant or latissimus dorsi-flap (LDF) is usually proposed according to patient’s wishes, previous treatment, patient’s morphology, breast cup-size and ptosis. Moreover, since a few years'
robotic mastectomy and or robotic LDF-IBR has been proposed [10–17].

Several publications proved the benefit of risk reducing nipple-sparing-mastectomy (NSM) in high risk patients [18–20], with a 90% reducing in BC development [18]. NSM studies reported better esthetic results than skin-sparing-mastectomy (SSM) and better quality of life [21,22]. Otherwise, quality of life and cosmetic outcomes seems to be similar between BCS and IBR [23]. NSM with IBR is considered as a valid procedure for prophylactic mastectomy and an acceptable option for BC [24–27]. Consequently, the demand of NSM by patients and the propositions of NSM by surgeons increased [28,29]. However few prospective studies were reported to evaluate complication rates and oncological outcomes of NSM [29].

The main techniques of IBR are definitive implant or tissue expanders and LDF. In a French study, IBR was performed in 404 patients (67.9%), with implants in 46.5% and LDF in 46.9% [8]. Complications rates ranged between 5 and 61% are difficult to compare between studies due to great disparities of IBR types, type of complications recorded, indications of mastectomy and time of survey.

We report our experience of IBR for consecutive mastectomies realized in a recent period of four years in order to determined immediate surgical results according to type of mastectomy and type of reconstruction, as main objectives.

2. Methods

2.1. Cohort study design

Among all consecutive mastectomies performed during years 2016–2019, we select patients with IBR from breast institutional database. A retrospective analysis with prospective data collection was performed in order to determined immediate surgical results according to type of mastectomy and reconstruction. Institutional committee approved this study (ClinicalTrial.gov n° NCT03461172 Database of Data Collection (BDD-G3S), Paoli Calmettes Institute, Marseille, France).

The work has been reported in line with the STROCSS [30].

2.2. Patients and outcomes

We analyzed patient’s characteristics such as age, body mass index (BMI), breast cup-size, ASA status (American Society of Anesthesiology score), diabetes and tobacco use. Tumor characteristics or prophylactic treatment, previous treatment received (neo-adjuvant chemotherapy, radiotherapy), surgical procedures of mastectomy and IBR, complications have also been listed.

Data were collected regarding patient and tumor characteristics, treatment received and years of treatment, surgical procedures of mastectomy and IBR, complications during post-operative 90-days.

Analyses were performed separately for all complications, breast complications, LDF complications and for endoscopic surgical procedures. Technics of endoscopic NSM and robotic LDF were reported previously [15–17]. Complication rate was analyzed with Clavien-Dindo grading [31]: Grade 3 corresponded to any complication which required re-operation, and Grade 4 corresponded to severe general infection. Grade 1 or 2 complications corresponded to infection or dehiscence or hematoma or bleeding or skin necrosis, without re-operation.

The duration of surgery was recorded from skin incision to the end of skin suture. The number of post-operative hospitalization days was reported from day of surgery to discharge. Interval-time between surgery and adjuvant chemotherapy (AC) or post-mastectomy radiotherapy (PMRT) were analyzed.

2.3. Procedures

Several techniques of IBR have been used for both NSM and SSM: sub-pectoral implant, tissue expanders or LDF, traditional open technique or robotic technic have been listed. The surgeon according to his habits chose incision. Patients underwent mastectomy with NAC conservation when distance between tumor and NAC was at least 2 cm on the preoperative imagery and a retro-mammary biopsy was performed.

2.4. Statistics

Quantitative criteria were analyzed with median, mean, CI95% and range. Comparisons were determined using Chi2-test for qualitative criteria and t-test for quantitative criteria. Factors significantly associated with criteria analyzed were determined by binary logistic regression adjusted for all significant variables determined by univariate analysis. Using Odds Ratio derived from logistic regression, we calculated a score for prediction of complications. Performance of this score was analyzed with calculation of area under the ROC curve (AUC). Statistical significance was set as p ≤ 0.05. Analyses were performed with SPSS version 16.0 (SPSS Inc., Chicago, Illinois).

3. Results

3.1. Population

We performed 1982 mastectomies: 1234 without IBR (60 bilateral: 4.9%) and 748 with IBR (37.7%) (134 bilateral: 17.9%). Characteristics of patients, surgery and treatments were reported in Table 1. Seven surgeons performed 728 mastectomies with IBR (97.3%) and 4 others surgeons performed 20 mastectomies with IBR.

3.2. Indications of mastectomies and neo-adjuvant treatments

Mastectomies were realized for 548 primitive BC (73.3%), 87 ILBCLR (11.6%) and 113 prophylactic mastectomies (15.1%) with bilateral mastectomies in 60 cases (10.9%), 7 cases (8%) and 67 (59.3%) respectively.

Neo-adjuvant chemotherapy (NAC) was performed before 104 mastectomies (13.9%) including 52 with NAC and neo-adjuvant radiotherapy (NAC-R) and including 2 standard mastectomies. Previous radiotherapy was realized in 89 mastectomies (11.9%) and in 52 mastectomies with NAC-R (7.0%).

3.3. Type of mastectomies

We realized 353 NSM (47.2%), 391 SSM (52.3%) and 4 standard mastectomies. NSM rate increased during the last 2 years: 56.5% (236/418) versus 38.5% (127/330) (p < 0.0001).

In univariate analysis, NSM versus SSM, was significantly associated with median age, breast cup-size, indication and histology, years of treatment, bilateral mastectomy and tobacco (Table 1). In multivariate analysis, we reported more SSM for breast cup-size C (OR: 1.642, CI95% 1.134–2.379, p = 0.009) or > C (OR: 1.780, CI95% 1.109–2.856, p = 0.017), primary BC (OR: 4.570, CI95% 1.345–15.52, p = 0.015) and less SSM during the two last years (OR: 0.617, CI95% 0.389–0.977, p = 0.039 and OR: 0.511, CI95% 0.318–0.820, p = 0.005) and for patients with tobacco use (OR: 0.673, CI95% 0.455–0.996, p = 0.048).

Incisions for SSM were central, around nipple areolar-complex (NACx) or elliptic. Incisions for 353 NSM were: 200 periphery breast incisions (11.6%) and 113 prophylactic mastectomies (15.1%) with bilateral mastectomies in 60 cases (10.9%), 7 cases (8%) and 67 (59.3%) respectively.

3.4. Type of reconstruction

IBR were performed in 551 mastectomies with implants (459 definitive implants and 92 expanders), in 196 with LDF (including 48 with concomitant definitive implant) and in 1 with exclusive secondary
lipofilling. IBR were performed with implant in 72.1% of primary BC (Table 2).

Median size of implants was 290 cc (mean 291, CI95% 283–298). Implant sizes were more than 300 cc in 38.3% of implant-IBR (176/460) and 58% of implant with LDF-IBR (29/50) (p = 0.006) (Supplementary Table 1).

LDF-IBR was performed in 1 prophylactic mastectomy (0.9%), in all 52 mastectomies after NAC-R, in 42 ILBCLR (48.8%) and in 101 primaries BC (101/496: 20.4%) including 4 among 9 mastectomies (44.4%) after previous radiotherapy for Hodgkin disease.

Type of reconstruction in 579 NSM or SSM, excluding 4 standard mastectomies, 113 prophylactic mastectomies (1 LDF-IBR) and 52 NAC-R (52 LDF-IBR): In univariate analysis, IBR with implant or with LDF ± implant, was significantly associated with indication, bilateral mastectomy, history, years of treatment, breast cup-size, age, NSM or SSM and BMI. In multivariate analysis, IBR with LDF versus implant was associated with lobular BC, year 2019, BMI, age >49-years old, breast cup-size C and SSM (Fig. 1).

3.5. Duration of surgery per patients (681 patients)

Median duration of surgery was 144 min (CI95% 166–180) (Supplementary Table 1): 437 ≤ 180min (64.2%) and 244 > 180min. In univariate analysis duration >180min was significantly associated with mastectomy weight, LDF-IBR, BMI, ALND, breast cup-size, indication and years of treatment. In multivariate analysis duration >180min was significantly associated with breast cup-size ≥ C (OR: 1.832, CI95% 1.001–3.352, p = 0.050 for 201 cup-size C and OR: 1.980, CI95% 0.905–4.334, p = 0.087 for 108 cup-size < C) and LDF-IBR versus implant-IBR (OR: 189, CI95% 83–432, p < 0.0001) for 484 implant-IBR and 196 LDF-IBR.

3.6. Complications

The overall complications crude rate was 31.4% (235/748) with 74 re-operations (9.9%). Implant loss rate was 5.8% (35/599): 4.7% (26/551) for implant or expander IBR (22/459 definitive implant and 4/92

### Table 1

| Characteristics of patients, surgery and treatments according type of mastectomy. |
|---|---|---|
| 744 mastectomies | NSM | SSM |
| excluding 4 standard mastectomies | Nb | % | Nb | % | p |
| Age ≤ median 49 | 201 | 56.9 | 180 | 46.0 | 0.002 |
| >49 years | 152 | 43.1 | 211 | 54.0 |
| Indication Primary | 214 | 60.6 | 332 | 84.9 | <0.0001 |
| Local recurrence | 39 | 11.0 | 46 | 11.8 |
| Prophylactic | 100 | 28.3 | 13 | 3.3 |
| Bilateral | No | 258 | 73.1 | 352 | 90.0 | <0.0001 |
| Yes | 76 | 26.9 | 39 | 10.0 |
| Years | 2016 | 72 | 20.4 | 87 | 22.3 | <0.0001 |
| 2017 | 55 | 15.6 | 116 | 29.7 |
| 2018 | 118 | 33.4 | 104 | 26.6 |
| 2019 | 108 | 30.6 | 84 | 21.5 |
| Radiotherapy | No | 248 | 70.3 | 251 | 64.2 | 0.019 |
| PMRT | 51 | 14.4 | 55 | 14.1 |
| Previous RTH | 40 | 11.3 | 47 | 12.0 |
| NAC ≥ N-RTH | 14 | 4.0 | 38 | 9.7 |
| Neo-adjuvant chemotherapy | Yes | 311 | 88.1 | 331 | 84.7 | 0.014 |
| No | 42 | 11.9 | 60 | 15.3 |
| Tobacco | No | 270 | 76.5 | 320 | 81.8 | 0.044 |
| Yes | 83 | 23.5 | 71 | 18.2 |
| Diabetes | No | 350 | 99.2 | 386 | 98.7 | 0.420 |
| Yes | 10 | 0.8 | 3 | 0.8 |
| ASA status | 1 | 156 | 44.3 | 181 | 46.3 | 0.857 |
| 2 | 189 | 53.7 | 203 | 51.9 |
| 3 | 7 | 2.0 | 1 | 0.2 |
| Breast cup size | A-B | 222 | 62.9 | 191 | 48.8 | 0.001 |
| C | 88 | 24.9 | 122 | 31.3 |
| > C | 43 | 12.2 | 22 | 5.9 |
| Histology | DCIS | 150 | 42.5 | 67 | 17.9 | 0.0001 |
| Ductal | 252 | 68.8 | 122 | 31.7 |
| Lobular | 47 | 13.3 | 44 | 11.4 |
| Others | 3 | 0.8 | 1 | 0.3 |
| No cancer | 99 | 28.0 | 14 | 3.6 |
| Axillary surgery | No | 184 | 52.1 | 132 | 33.8 | 0.0001 |
| SLNB | 140 | 39.7 | 206 | 52.7 |
| ALND | 29 | 8.2 | 53 | 13.6 |
| Implant | Definitive | 261 | 95.6 | 198 | 71.2 | <0.0001 |
| Expander | 12 | 4.4 | 80 | 28.8 |
| LDF | no autologous autologous | 50 | 38.0 | 69 | 20.4 | 0.006 |
| 49 | 38.0 | 90 | 26.8 |
| LDF ± implant | without implant | 56 | 88 | 86 | 86 |
| with implant | 23 | 25 | 25 | 25 |
| Robotic NSM | No | 242 | 68.6 | 391 | 100 | <0.0001 |
| Yes | 111 | 31.4 | 0 | 0 |
| Robotic LDF | No | 4 | 5.1 | 63 | 55.8 | <0.0001 |
| Yes | 75 | 94.9 | 50 | 44.2 |

Legend: PMRT: post mastectomy radiotherapy, RTH: radiotherapy, NAC: neo-adjuvant chemotherapy, N-RTH: neo-adjuvant radiotherapy, DCIS: ductal carcinoma in-situ, SLNB: sentinel lymph node biopsy, ALND: axillary lymph node dissection, LDF: latissimus dorsi-flap, NSM: nipple sparing mastectomy.
expander) and 18.75% (9/48) for LDF with combined implant-IBR (p = 0.001). There was no significant difference between previous radiotherapy or not: 9.9% (8/81) and 5.2% (27/518), respectively (p = 0.085).

In univariate analysis complication rate was significantly associated with median age, BMI < or \( \geq \) 25, ASA status, tobacco use, breast cup-size, NAC, years of treatment, IBR type, ALND, radiotherapy and mastectomy weight. In logistic regression, factors significantly associated with complication were: tobacco use (OR: 2.249, CI 95% 1.50–3.38, p < 0.0001), LDF-IBR (OR: 3.265, CI 95% 2.08–5.14, p < 0.0001) and LDF with Implant (OR: 3.735, CI95% 1.80–7.77, p < 0.0001) versus Implant-IBR, breast cup-size C (OR: 1.605, CI 95% 1.03–2.50, p = 0.036) and >C (OR: 2.147, CI 95% 1.24–3.73, p = 0.007) versus cup-size < C. Using these OR, predictive score of complications was between 2 and 8.14 values and was calculated with the equation reported in Fig. 2. This score was significantly associated with complication (p < 0.0001) and complication Grade 2–3 (p = 0.009). Simplified score determined 3 categories (Supplementary Table 2, Fig. 2) with a significant association with complications (AUC: 0.698, CI 95% 0.656–0.739) and complications Grade 2–3 (AUC: 0.575, CI 95% 0.512–0.638).

Breast complications occurred in 32.9% of mastectomies (171/748) with 89 grade 1 (52% of complications), 14 grade 2 (8.2%), 67 grade 3 (39.2%) and 1 grade 4 (septic shock with bilateral implant loss).

Type of complications were: 86 skin and or NACx suffering or necrosis (50.3%: including 21 Grade 2–3), 39 hematomas (22.8%: including 32 Grade 2–3), 26 infections (15.2%: all Grade 2–3) and 20 other complications (11.7%: including 3 Grade 2–3). Breast complications Grade 2-3-4 were significantly associated in univariate analysis only with tobacco use (p = 0.033, OR: 2.064, CI95% 1.43–2.97, p < 0.0001). LDF rates were significantly associated with type of complication: 15.9% (10/63) for skin or NACx suffering or necrosis, 15.2% (5/33) for hematomas, 80.0% (20/25) for infections and 0% (0/18) for others complications (p < 0.0001).

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**Fig. 1.** Odds ratio (OR) of regression analysis: Latissimus Dorsi Flap IBR versus Implant IBR for 579 NSM or SSM excluding prophylactic mastectomies, NAC-R and standard mastectomies.

**Legend:** OR: Odds ratio, SSM: skin sparing mastectomy, BMI: body mass index, BC: breast cancer.

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**Fig. 2.** Predictive simplified score of complications.

**Legends:** Score 1: 373 patients (50.0%), Score 2: 237 patients (31.8%), Score 3: 136 patients (18.2%). *: p < 0.0001, ◦: p = 0.018.

Equation: tobacco (0 or 1) + type of IBR (1 or 3.265 or 3.735) + breast cup-size (1 or 1.605 or 2.147).

**Type of IBR:** Implant = 1, LDF (latissimus dorsi-flap) = 3.265, LDF + implant = 3.735.

**Breast cup-size:** A-B = 1, C = 1.605, >C = 2.147.

**Values:** Score 1: 2 to 2.60. Score 2: 3.15 to 4.85. Score 3: >4.85.

Overall breast complications rates, breast complications rates Grade ≥ 2 and skin or NACx suffering or necrosis rates for NSM according to breast incision are reported in Table 3.
conventional LDF. Grade 2–3-4 complications rates were 10% for implant-IBR, 9.7% for LDF-IBR and 15.4% for LDF with implant-IBR (non-significant).

3.7. Post-operative hospitalization length (POHL) per patients

Median POHL was 2 days (CI95% 2.51–2.74): 2 and 4 days for implant-IBR and LDF-IBR, respectively (p < 0.0001) (Supplementary Table 1). Median POHL were 2 days (mean: 2.54, CI95% 2.43–2.65, range: 1–8) and 3 days (mean: 3.32, CI95% 2.84–3.80, range 1–14) for patients without and with complications Grade 2–3, respectively (p = 0.002).

3.8. Endoscopic procedures

Endoscopic NSM, 108 robotic-NSM (R-NSM) and 3 endoscopic without robotic assistance, were performed (31.4%) by 2 surgeons. R-LDF was performed for 125 IBR (63.8%: 125/196 LDF-IBR, 50 for NSM and 75 for NSM) by 3 surgeons, in 40 cases with LDF-IBR combined with implant (32%).

Durations of surgery for R-NSM, non-R-NSM, endoscopic-NSM and for patients with LDF-IBR (Robotic or non-Robotic LDF) with NSM or non-robotic NSM are reported in Table 4.

For patients with NSM and implant-IBR, in univariate analysis, duration >130min were significantly associated with endoscopic or robotic NSM (40/49 vs 73/175: p < 0.0001), bilateral NSM (36/46 vs 77/178: p < 0.0001), mastectomy weight >300gr (58/91 vs 55/133: p = 0.001), without difference between years, breast cup-size, indication of NSM. In multivariate analysis, these factors remains significant: R-NSM (OR: 8.25, CI95% 3.55–19.2, p < 0.0001), bilateral NSM (OR: 8.05, CI95% 3.52–18.4) and mastectomy weight >300gr (OR: 2.80, CI95% 1.49–5.28, p = 0.001).

3.9. Pathologic results and treatment

Median mastectomy weight were 308.5gr (CI95% 340–372) with significant higher weight for SSN versus NSM and for LDF-IBR versus implant-IBR (Supplementary Table 1).

Table 3 Breast complications rates for NSM according to breast incision.

| incisions | periphery | areolar | radial | inverted T | p
|-----------|-----------|---------|--------|-----------|---|
| % complication | (patients number) | (Yield) | (Yield) | (Yield) | (Yield) |
| SSM | 25.5 | (51/200) | (13/54) | (8/11) | <0.05 |
| R-NSM | 13.5 | (27/200) | (14/88) | (2/11) | 0.070 |
| skin or NACx | 13.5 | (27/200) | (13/88) | (5/11) | <0.05 |

Legend: G2-3: Grade 2–3, NACx: nipple areolar complex.

NSM rates were significantly different according to pathologic results of mastectomies: 35.3% for DCIS, 41.8% for invasive BC and 87.6% for prophylactic mastectomies (p < 0.0001) (Table 1).

NAC was performed in 102 patients (including 52 with NAC + N-RTH) and endocrine therapy in 354 patients with primary BC (64.6%) and in 47 ILBCLR (54.0%). Previous radiotherapy was realized in 140 mastectomies (18.7%): 88 with ILBCLR or radiotherapy for Hodgkin disease and 52 patients with NAC + N-RTH. PMRT was realized in 107 mastectomies (61 with implant-IBR, 17 with expander, 22 with LDF-IBR and 7 with implant-LDF-IBR) and AC was done in 147 patients.

Median interval time between surgery and first adjuvant treatment was 44 days: 43 and 60 days for AC and PMRT, respectively. Median interval time between surgery and first adjuvant treatment were 43 and 54 days for mastectomies without and with Grade 2–3 complications, respectively (p = 0.042). According to type of complication, median interval times were not significantly different (Supplementary Table 3).

4. Discussion

In our study with a large number of patients, the overall complications crude rate was 31.4% with 74 re-operations (9.9%) and 35 implant losses (5.8%). Grade 2–3 breast-complication rate was 10.96%, significantly associated with tobacco use: 10% for implant-IBR, 9.7% for LDF-IBR and 15.4% for LDF-implant-IBR. There was no significant difference of complications rates between R-LDF and traditional LDF. Using our simplified score we are able to evaluate risk of complications before surgery which can help the decision and type of IBR in agreement with patient’s wishes.

Even if comparison of complications rates between studies is difficult due to a great disparity of IBR types, complications recorded, indications of mastectomy and time of survey, we reported an overall complication rate similar with others studies [32–39]. However, complications rates reported in recent studies for NSM-IBR, were lower (5.1–20%) and the average overall complication rate were 20.5% in a recent review of 3716 prophylactic-NSM [25].

We reported a 4.7% rate of implant loss for implant-IBR, mainly in relation with infectious complication, even with use of pre-operative antimicrobial therapy for patients with nasal-germs and per-operative antimicrobial-prophylaxis. This rate was lower than rates reported by others [32,33,38]. Implant loss rate was higher for LDF with combined implant-IBR in our study. In literature, the more frequent complication was infection (0%–17.8%) with implant loss reported between 1.0% and 9.9%. Wound infection rate was 9.8% (230/2434) in Bennett et al. study [39] with a reconstructive failure rate of 7.1% (116/1637). Moreover, obesity was associated with higher risks of any complication in a recent study, in agreement with our results [40].

Major complication rate: Like others authors we observed higher breast complication rate Grade 2–3 with tobacco use (OR = 2.064): higher failure rate [41,42], higher flap necrosis rate [43–45] and higher infection rate [36,42,45]. Major complications rates, grade 3 with re-operation and/or re-hospitalization, reported in literature were comprised between 9 and 37% but with different IBR procedures, different criteria of complications recorded and different time of survey. In a multicenter prospective cohort study [39] reoperation rate was 19.3% (453/2343). In the large NMBRA-cohort with 3389 IBR, this rate was 15.8% [41]. In Srinivasa et al. study [40], obesity was significantly associated with higher risk of major complication in both implant reconstruction (OR = 1.71) and autologous reconstruction (OR = 2.72). It is interesting to note that complications Grade 2–3 had, in our study, a significant impact on interval time between surgery and adjuvant treatment with possible negative impact on prognosis. This topic was not analyzed in others studies.

We reported a high rate of NSM (47.2%) particularly during the last 2-years (56.5%). In the MRROC study [37], NSM rate was 17.7% (287/1625) for implant reconstructions. Potential disadvantages of SSN and NSM include residual breast tissue under nipple-areolar-complex
studies reported by Wilkins, Bennett, Srinivasa and Dauplat [8, 38] to traditional surgery such as a smaller incision, better surgical expo
breast reconstruction in 175 patients compared to 236 sub-muscular
choice after radiotherapy, because LDF protect and nourish skin flaps. A
and 53.5% with LDF in 3.3%, 3.0%, 4.8% and 46.9%, respectively in
studies reported by Wilkins, Bennett, Srinivasa and Dauplat [8, 38–40].
LDF-IBR were performed in 67.1% (94/140) of our patients with
previous radiotherapy. We think that LDF-reconstruction is a good
choice after radiotherapy, because LDF protect and nourish skin flaps. A
prospective multicenter study [23] shows that autologous reconstruction
appears to yield a superior patient-reported satisfaction and lower
risk of complications than implant placement among patients receiving
PMRT. Shibany et al. were specifically interested in pre-pectoral implant
breast reconstruction in 175 patients compared to 236 sub-muscular
reconstruction and have shown no significant differences in complica-
tion rates: 15.4% versus 19.3% [63].
Robotic surgery: Currently, only a few studies have looked at series
of patients who underwent R-NSM. Sarfati et al. reported 63 prophyl-
actic R-NSM with no mastectomy skin flap or NACx necrosis, 4.8% of
infections and 1.6% implant loss [10]. For Toescu et al., with 94 R-NSM
procedures, the rate of reoperation was 4.3%, flap or nipple necrosis at
1.1% and they did not highlight local recurrences [64]. Endoscopic
procedure is an emerging technique that has not yet been fully validated.
This allows a NSM with a unique axillary approach with endoscopic or
robotic technic, which is now well determined [65] but contribution of
these procedures in comparison with traditional-NSM must be
confirmed by prospective studies with analysis of complication rates,
aesthetics advantages and cost efficiency. All recent studies about
R-NSM showed that this technic could be performed with a brief
learning curve [14–17,65–67].
In our study we reported 236 endoscopic procedures: 111 R-NSM and
125 R-LDF. The complication rate was not higher for R-LDF than
conventional-LDF, but longer duration of surgery for NSM-implant-IBR
was significantly associated with the robotic procedures. A recent
mono-centric study, on 91 Endoscopic-NSM and 40 R-NSM showed that
R-NSM is associated with higher satisfaction but at the price of longer
operation and higher medical cost [66] and two studies showed that
endoscopic surgery were associated with a better esthetic outcome [68,
69]. Robotic-LDF appears as a safe, reproducible and contributive pro-
cedure when skin paddle is not required with any dorsal scar and less
pain without significant longer procedure [15,16]. This can be explained
by the enhanced surgical exposure resulting in the minimization of tis-
sue traction and the resultant tissue trauma and skin necrosis. Clemens
et al. published similar results and concluded that R-LDF harvesting is an
efficient technique with low complication rate (16.7% among 12 R-LDF
versus 37.5% among 64 Traditional-LDF) [70].
Robotic surgery is associated with many advantages when compared to
traditional surgery such as a smaller incision, better surgical expo-
sure, decreased tissue trauma and an enhanced viability of the LDF.
Acquiring a good experience in robotic surgery (pelvic or breast) is
considered crucial; this can be accomplished while assisting more
experienced surgeons especially with a dual robot console.
Radiotherapy: In a recent review, Ho et al. [71] wondered if IBR and
PMRT combination were possible while minimizing the frequency of
complications without compromising oncological or cosmetic outcomes.
It seemed like IBR and PMRT were compatible. Otherwise autologous
reconstructions tolerate radiotherapy better compared with implants.
However, implants remain the predominant type of reconstruction
because it preserve the option of delayed autologous reconstruction
[71]. In our study PMRT was realized for 107 patients with implant-IBR
(72.9%). Reverberi et al. have shown that the type of reconstruction
does not influence late toxicity rate: 25.3% among 91 IBR with PMRT
[72]. Regarding oncological safety of IBR with PMRT, Bjohle et al. [73]
in a matched cohort study with implant-IBR patients (n = 128) compared
to patients without implant (n = 252) observed no difference in
survival and recurrence [73].
Several limits of our study can be underlined: post-operative com-
lications were recorded only during 90-days and we can’t evaluate
patient’s satisfaction and quality of life.

5. Conclusion

In conclusion, IBR were performed in 37.7% of mastectomies and
after RTH in 18.9%, with NSM in 47.2% and more NSM during the 2 last
years. LDF-IBR was performed in 26.2% of all mastectomies with IBR.
More LDF-IBR for high BMI and high breast cup-size were performed for
primary BC and LDF-IBR were frequently performed for patients with
NAC-R and local recurrence.
Mastectomy with IBR for local recurrence seems to be a safe tech-
nique with an acceptable complication rate, which is increased by to-
bacco use. This technique can be proposed after a strict selection of
patient’s characteristics and informed the patient of the risk of
increasing the interval time for adjuvant treatments in the event of
complications. Predictive score to evaluate the complication rate could
be used to informed patients to help the decision with patient wishes.
Otherwise, robotic surgery is associated with many advantages but
needs complementary evaluation by a prospective study.

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Declaration of competing interest

The authors declare that there are no conflicts of interest regarding this study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.
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Data statement

The database used and/or analyzed during the current study are not
publicly available, but can be available from the corresponding author
on reasonable request.

CRediT authorship contribution statement

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Not applicable.

Institutional committee approval

This study was approved by the French National Commission for Data Processing and Liberty (CNIL) and the Institutional Review Board of the University of Geneva (13 July 2012) under file number 2012-0043801.
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