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Mastectomy with Immediate Breast Reconstruction with or without Robotic Surgery: Results of 310 Consecutive Patients in 2-Years

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Abstract

Background: Immediate Breast Reconstruction (IBR) is offered according to patient's wishes, previous treatment, breast cup-size and ptosis. We analyze a 2-years' experience of consecutive patients with IBR after Skin-Sparing-Mastectomy (SSM) or Nipple-Sparing-Mastectomy (NSM) with or without robotic procedure.

Methods: Among 854 mastectomies we performed 310 IBR (36.3%). Characteristics of patients and surgery, complication rate, time of surgery, Post-Operative Hospitalization (POH) stay were determined.

Results: NSM were realized in 112 patients (36.1%). Implant-IBR was performed for 211 patients (68.1%) and Latissimus-Dorsi-Flap (LDF) for 99 patients (31.9%): robotic-NSM in 22.3% (25/112) of NSM, robotic LDF in 60.6% (60/99). Significant factors associated with LDF-IBR were BMI 25-29.9 and >30 (OR=2.749 and 4.027), previous radiotherapy (OR=7.313) and neo-adjuvant-chemotherapy (OR=4.839). The overall complication rate was 31.9% (99/310) with 29 re-operations (9.4%). Significant factors associated with any complication were cup-size>C (OR=2.165), LDF-IBR (OR=3.990), robotic-NSM (OR=3.953). Complications rates grade 2-3-4 were: 10.3% (32/310) for breast complications and 2.0% (2/99) for LDF. Implant loss rate was 4.6% (11/237). Significant factors associated with Grade 2-3 breast complications were robotic-NSM (OR=5.983) and tobacco (OR=2.234). Significant factors associated with POH>3-days were LDF-IBR (OR=21.77) and mastectomy for ipsilateral-local-recurrence (OR=5.786). Significant factors associated with time of surgery >180mn were cup-size>C (OR=3.581), LDF-IBR (OR=779) and bilateral mastectomy (OR=9.335).

Conclusion: We reported a high rate of IBR and NSM and an increase of LDF reconstruction. IBR for ipsilateral -local-recurrence with LDF was the preferred procedure. Robotic-LDF reconstruction without dorsal scar was realized in 60.6% of patients with a low complication rate.

Keywords: Immediate breast reconstruction; Breast cancer; Robotic surgery; Mastectomy

Abbreviations

IBR: Immediate Breast Reconstruction; SSM: Skin-Sparing-Mastectomy; NSM: Nipple-Sparing-Mastectomy; POH: Post-Operative Hospitalization; LDF: Latissimus-Dorsi-Flap; BC: Breast Cancer; NAC: Neo-Adjuvant Chemotherapy; ILBCR: Ipsilateral Local BC-Recurrence; BMI: Body Mass Index; PMRT: Post Mastectomy Radiotherapy; ALND: Axillary Lymph Node Dissection; DCIS: Ductal Carcinoma *In Situ*; DIEP: Deep Inferior Epigastric Perforator; TRAM: Transverse Rectus Abdominis Musculocutaneous; ERAS: Enhanced Recovery After Surgery.

Introduction

Mastectomy with Immediate Breast Reconstruction (IBR) is a surgical strategy in Breast Cancer (BC) when breast-conserving surgery is not an option. This treatment strategy is also increasingly being used after Neo-Adjuvant Chemotherapy (NAC). In Skin-Sparing Mastectomy (SSM) the gland is removed and the whole breast skin is preserved. In Nipple-Sparing Mastectomy (NSM), the Nipple-Areolar Complex (NACx) is preserved as well as the skin. These conservative mastectomies are associated with superior aesthetic outcomes and patient satisfaction compared to non-conservative mastectomy. In a recent French large 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 [1]. However, potential disadvantages include residual breast tissue under NACx or under the skin flaps and an increased risk of mastectomy skin flap or NAC necrosis [2].

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, how much money they made, and her race/ethnicity [3]. In France, all reconstruction fees can be without financial

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Table 1: Characteristics of patients according to Skin Sparing Mastectomy (SSM) or Nipple Sparing Mastectomy (NSM) and according to robotic or non-robotic surgery.

		All patients	SSM Nb	%	NSM Nb	%	Chi² *p*	Non-Robotic		Robotic		Chi² *p*
								Nb	%	Nb	%	
All patients		310	198	63.9	112	36.1		243		67		
Mastectomy	SSM		198					170	70.0	28	41.8	**<0.0001**
	NSM				112			73	30.0	39*	58.2	
Bilateralmastectomy		21	6	3.0	15	13.4	**0.001**	21	8.6	0	0	**0.005**
Implant	definitive	169	94	47.5	75	67.0	**<0.001**	162	66.7	7	10.4	**<0.0001**
	expander	42	40	20.2	2	1.8		42	17.3	0	0	
LDF	autologous	68	47	23.7	21	18.7		36	14.8	32	47.8	
	non-autologous	5	1	0.5	4	3.6		1	0.4	4	6.0	
	with implant	26	16	8.1	10	8.9		2	0.8	24	35.8	
Indication	breast cancer	229	165	83.3	64	57.1	**<0.0001**	184	75.7	45	67.2	**<0.0001**
	local recurrence	45	25	12.6	20	17.9		24	9.9	21	31.3	
	prophylactic	36	8	4.0	28	25.0		35	14.4	1	1.5	
Previous radiotherapy	No	243	156	78.8	87	77.7	0.463	206	84.8	37	55.2	**<0.0001**
	Yes	67	42	21.2	25	22.3		37	15.2	30	44.8	
Chemotherapy	No	204	128	64.7	76	67.9	0.80	168	69.1	36	53.7	**0.03**
	Adjuvant	71	47	23.7	24	21.4		53	21.8	18	26.9	
	Neo-adjuvant	35	23	11.6	12	10.7		22	9.1	13	19.4	
Axillarysurgery	No	131	67	33.8	64	57.1	**<0.001**	99	40.7	32	47.8	**0.005**
	SLNB	146	106	53.5	40	35.7		124	51.0	22	32.8	
	ALND	33	25	12.6	8	7.1		20	8.2	13	19.4	
Year of surgery	2016	143	84	42.4	59	52.7	**0.053**	124	51.0	19	28.4	**0.001**
	2017	167	114	57.6	53	47.3		119	49.0	48	71.6	
ASA status	1	141	90	45.4	51	45.5	0.471	114	46.9	27	40.3	0.520
	2	162	102	51.6	60	53.6		123	50.6	39	58.2	
	3	7	6	3.0	1	0.9		6	2.5	1	1.5	
Previous BCS	No	189	115	58.1	74	66.1	0.103	156	64.2	33	49.3	**0.019**
	Yes	121	83	41.9	38	33.9		87	35.8	34	50.7	
Tobacco	No	251	163	82.3	88	78.6	0.254	200	82.3	51	76.1	0.167
	Yes	59	35	17.7	24	21.4		43	17.7	16	23.9	
BMI	≤ 24.9	240	143	72.2	97	86.6	**0.014**	194	79.8	46	68.7	0.108
	25-29.9	54	42	21.2	12	10.7		39	16.0	15	22.4	
	≥ 30	16	13	6.6	3	2.7		10	4.1	6	9.0	
POH	≤ 3days	227	147	74.2	80	71.4	0.341	203	83.5	24	35.8	**<0.0001**
	> 3days	83	51	25.8	32	28.6		40	16.5	43	64.2	
mastectomyweight	≤ 300gr	153	83	41.9	70	62.5	**<0.0001**	121	49.8	32	47.8	0.438
	> 300gr	157	115	58.1	42	37.5		122	50.2	35	52.2	
Histology	DCIS	72	54	27.3	18	16.1	**<0.0001**	60	24.7	12	17.9	**0.004**
	invasive	201	136	68.7	65	58.0		147	60.5	54	80.6	
	benign	37	8	4.0	29	25.9		36	14.8	1	1.5	
Syntheticmesh		7	3	1.5	4	3.6		7	2.9	0	0	
Cup size	≤ C	264	163	82.3	101	90.2	**0.042**	207	85.2	57	85.1	0.558
	> C	46	35	17.7	11	9.8		36	14.8	10	14.9	

SSM: Skin Sparing Mastectomy; NSM: Nipple Sparing Mastectomy; LDF: Latissimus Dorsi-Flap; SLNB: Sentinel Lymph Node Biopsy; ALND: Axillary Lymph Node Dissection; BCS: Breast Conservative Surgery; BMI: Body Mass Index; POH: Post-Operative Hospitalization; DCIS: Ductal Carcinoma *in Situ.*

Table 2: Characteristics of patients according to type of Immediate Breast Reconstruction (IBR).

		Implant/Expander		LDF		LDF + implant		Chi² *p*
		Nb	%	Nb	%	Nb	%	
All patients		211	68.1	73	23.5	26	8.4	
Mastectomy	SSM	134	63.5	48	65.8	16	61.5	0.911
	NSM	77	36.5	25	34.2	10	38.5	
Bilateralmastectomy		21	10.0	0		0		0.005
Indication	breast cancer	159	75.4	52	71.2	18	69.2	<0.0001
	local recurrence	16	7.6	21	28.8	8	30.8	
	prophylactic	36	17.1	0		0		
Previousradiotherapy	No	195	92.4	39	53.4	9	34.6	**<0.0001**
	Yes	16	7.6	34	46.6	17	65.4	
Chemotherapy	No	154	73.0	40	54.8	10	38.5	<0.0001
	Adjuvant	48	22.7	19	26.0	4	15.4	
	Neo-adjuvant	9	4.3	14	19.2	12	46.1	
Axillarysurgery	No	81	38.4	36	49.3	14	53.8	<0.001
	SLNB	117	55.4	25	34.2	4	15.4	
	ALND	13	6.2	12	16.4	8	30.8	
Year of surgery	2016	102	48.3	29	39.7	12	46.2	0.445
	2017	109	51.7	44	60.3	14	53.8	
ASA status	1	102	48.3	28	38.4	11	42.3	0.550
	2	104	49.3	43	58.9	15	57.7	
	3	5	2.4	2	2.7	0	0	
Previous BCS	No	144	68.2	34	46.6	11	42.3	0.001
	Yes	67	31.8	39	53.4	15	57.7	
Tobacco	No	176	83.4	56	76.7	19	73.1	0.256
	Yes	35	16.6	17	23.3	7	26.9	
BMI	≤ 24.9	173	82.0	52	71.2	15	57.7	0.030
	25-29.9	30	14.2	15	20.5	9	34.6	
	≥ 30	8	3.8	6	8.2	2	7.7	
POH	≤ 3days	194	91.9	29	39.7	4	15.4	<0.0001
	> 3days	17	8.1	44	60.3	22	84.6	
Mastectomy weight	≤ 300gr	106	50.2	41	56.2	6	23.1	0.014
	> 300gr	105	49.8	32	43.8	20	76.9	
Histology	DCIS	56	26.5	12	16.4	4	15.4	<0.0001
	invasive	119	56.4	60	82.2	22	84.6	
	benign	36	17.1	1	1.4	0	0	
Syntheticmesh		7	100	0		0		
Cup size	≤ C	180	85.3	67	91.8	17	65.4	**0.005**
	> C	31	14.7	6	8.2	9	34.6	

SSM: Skin Sparing Mastectomy; NSM: Nipple Sparing Mastectomy; LDF: Latissimus Dorsi-Flap; SLNB: Sentinel Lymph Node Biopsy; ALND: Axillary Lymph Node Dissection; BCS: Breast Conservative Surgery; BMI: Body Mass Index; POH: Post-Operative Hospitalization; DCIS: Ductal Carcinoma *in Situ.*

charge for patients. Reconstruction with implant or Latissimus Dorsi-Flap (LDF) is usually proposed according to patient's wishes, previous treatment, breast cup-size and ptosis. Moreover, since a few years' robotic mastectomy and or robotic LDF-IBR has been proposed [4-10]. The purpose of this study was to analyze a 2-year experience of consecutive patients with IBR after SSM or NSM with or without robotic procedure. The main aim of this study was feasibility and complications rates.

Materials & Methods

During 2-years (2016-17), 854 mastectomies were performed, including 310 with IBR (36.3%): 229 IBR among 690 mastectomies for

primary BC (33.2%), 45 IBR among 126 mastectomies for ipsilateral local BC-recurrence (ILBCR) (35.7%) and 36 IBR for prophylactic mastectomy. For primary BC, 30 IBR were performed among 144 patients after NAC (20.8%) and 199 IBR among 546 patients without NAC (36.4%). This present study report retrospective analysis of 310 patients with IBR from institutional BC data base with distinction between robotic or non-robotic surgery. A program of robotic breast surgery has been started in February 2016 [11]. All patients were informed of robotic assistance surgery. Our institutional ethical committee approved robotic breast surgery procedures.

NSM had been undertaken for prophylactic mastectomy and for BC with a minimal 2 centimeters tumor-nipple distance on mammography and or MRI. Robotic muscular latissimus flap without skin-island was used for NSM and for SSM or wise pattern skin reducing mastectomy in order to avoid dorsal scar after patient's information and choice. Robotics surgeries were achieved by two surgeons and the determination between robotic assisted or conventional surgery was in relation with availability of robotic operative room and choice of surgeon. Allocation of breast reconstruction operation type was depending patient's wishes and surgeon's choice in relation with breast volume and ptosis. We define autologous LDF or muscular latissimus flap as muscular flap harvested with fat around muscle and non-autologous LDF when fat around muscle was not harvested. At the end of robotic NSM, a biopsy of retro NACx tissue was performed and complete gland removal verification through axillar incision was systematically achieved [11].

Characteristics of patients and surgery were determined by age, BMI, indication of mastectomy, bilateral mastectomy, type of IBR and mastectomy, axillary surgery, ASA status, year of surgery, previous radiotherapy, NAC, previous conservative ipsilateral surgery, breast cup-size, mastectomy weight, tobacco use, diabetes, robotic mastectomy and/or robotic LDF (DaVinci SI or XI), bilateral mastectomy, Post-Operative Hospitalization (POH) stay, time of anesthesia and surgery. Breast cup-size had been compared with mastectomy weight in order to validate this qualitative criterion. Complication rate was analyzed with Clavien-Dindo grading [12] for all patients, for breast complications and for dorsal complications respectively. Grade 3 corresponded to any complication which requires 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 but without necessity of re-operation.

The duration of anesthesia was recorded from anesthesia induction to tracheal extubation including pectoral bloc local anesthesia and the duration of surgery included all procedures and the times for changing surgical postures, from skin incision to the end of skin suture. The number of POH days was reported from day of surgery to discharge. Interval-time between surgery and adjuvant chemotherapy and or Post Mastectomy Radiotherapy (PMRT) was analyzed.

Statistics

Quantitative criteria were analyzed with median, mean, CI 95% and range. Comparisons were determined using Chi2-test for qualitative criteria and t-test for quantitative criteria. Binary logistic regression was used to determined independent significant criteria. Analysis was evaluated per patient number. P-value <= 0.05 was considered as significant.

Results

During 2-years (2016-17), 310 patients were operated (331 IBR with 21 bilateral IBR): 229 (73.9%) for primary BC, 45 (14.5%) for ILBCR and 36 (11.6%) for prophylactic mastectomy, with 112 NSM (36.1%), 197 SSM (63.5%) and 1 standard mastectomy (0.3%). NSM were achieved in 27.9% for primary BC (64/229) (57/199: 28.6% without NAC and 7/30: 23.3% with NAC), 44.4% for ILBCR (20/45) and 77.8% for prophylactic mastectomy (28/36) (Table 1). For patients with bilateral mastectomy (15 NSM and 6 SSM), IBR were performed with definitive implant in 20 cases and expander implant in 1 patient. Breast cup-size was significantly correlated with mastectomy weight.

For patients with breast implant alone or in association with LDF, we realized a nasal research of staphylococcus germ and pre-operative antimicrobial therapy for patients with potage germs. Then, per-operative antimicrobial-prophylaxis was systematically performed for all patients with IBR.

Robotic NSM was achieved in 22.3% (25/112) of NSM, robotic dorsi-flap in 60.6% (60/99) including 18 patients with robotic-NSM and robotic LDF-IBR. All robotic procedures were performed by two surgeons: 67 robotic procedures among 133 surgeries (50.4%), 25 robotic-NSM among 61 NSM (41.0%) and 60robotic-LDF-IBR among 62 dorsi-flap (96.8%). For SSM, robotic-LDF was harvested through incision of NACx resection. For robotic-NSM, we used short axillar incisions for mastectomy and LDF dissection.

Previous radiotherapy was reported in 67 cases (67/274 IBR for BC: 24.4%): 44 patients with ILBCR (1 patient without previous radiotherapy), 22 patients with previous chemotherapy and radiotherapy before mastectomy with IBR using dorsi-flap [13,14] and 1 patient with complementary mastectomy for BRCA mutation after NAC and radiotherapy.

Type of IBR

Implant-IBR were achieved for 211 patients (68.1%), including 19.9% with expander implants (42/211) and LDF for 99 patients (31.9%) with 76 autologous-LDF (8 associated with implant), 5 non-autologous-LDF without implant and 18 non-autologous dorsi-flap

Table 3: Complications and grade Clavien Dindo.

	No		Grade 1		Grade 2		Grade 3		Grade 4	
	Nb	%	Nb	%	Nb	%	Nb	%	Nb	%
Breast	239	77.1	39	12.6	5	1.6	26	8.4	1	0.3
Dorsal (n=99)	58	58.6	39	39.4	0	0	2	2.0	0	0
Breast & Dorsal	211	68.1	65	21.0	5	1.6	28	9.0	1	0.3
Breast complication										
Implant	167	79.1	23	10.9	1	0.5	19	9.0	1	0.5
LDF	55	75.3	11	15.1	4	5.6	3	4.1	0	
LDF + implant	17	65.4	5	19.2	0		4	15.4	0	
LDF complication										
Robotic LDF	34	56.7	25	41.7	0		1	1.7	0	
non-robotic LDF	24	61.5	14	35.9	0		1	2.6	0	

LDF: Latissimus Dorsi-Flap

with implant (Table 2). A titanium-coated polypropylene mesh, specifically TiLoop® Bra (TiLOOP® Bra, pfm medical, Cologne, Germany) was used in 7 patients among 169 definitive implant-IBR (4.1%), for 2 patients with cup-size C and 3with cup-size >C, without PMRT and with previous radiotherapy in 2 cases.

Median implant-size was 292cc (mean=294, CI 95%=281-306, range=100-510), 290cc for implant-IBR (mean=287, CI 95%=275-300, range=100-510) and 340cc for combined implant and LDF-IBR (mean=333, CI 95%=297-369, range=105-490).

In univariate analysis, significant criteria associated with IBR using implant or LDF were BMI, ALND, previous radiotherapy, NAC, previous conservative ipsilateral surgery, indication of mastectomy and robotic-mastectomy. In multivariate analysis, adjusted on BMI (<24.9, 25-29.9, >30), previous radiotherapy, NAC and previous conservative ipsilateral surgery, significant factors associated with LDF-IBR were BMI 25-29.9 and >30 (Odds ratios=2.749 and 4.027, CI 95%=1.34-5.63 and 1.26-12.9, p=0.006 and 0.019, respectively), previous radiotherapy (OR=7.313, CI 95%=3.43-15.6, p<0.0001), NAC (OR=4.839, CI 95%=1.84-12.7, p=0.001).

Complications

The overall complication rate was 31.9% (99/310) with 29 re-operations (29/310: 9.4%). Grades of complications are reported in (Table 3): two grades 3 LDF complications were observed with re-operation for bleeding. All others LDF complications were dorsal seroma, which needed evacuation. Any muscle necrosis occurred. Five patients have diabetes (1.6%) which required treatment and complication rates were not different between patients with diabetes (3/5: 60.0%) in comparison with patients without diabetes (96/305: 31.5%) (p=0.188).

In univariate analysis, significant criteria associated with any complications were ALND, previous radiotherapy, tobacco, cup-size, IBR with implant versus dorsi-flap and robotic versus conventional mastectomy. There were no significant difference between autologous and non-autologous LDF-IBR (39/76: 51.3% versus 16/23: 69.6%, respectively, p=0.095), between definitive-implant versus expander-implant (31/169: 18.3% versus 13/42: 31.0%, p=0.060) and between LDF-IBR versus LDF with breast-implant (39/73: 53.4% versus 16/26: 61.5%, p=0.45). There were no significant difference between NSM and SSM (39/112: 34.8% versus 60/198: 30.3%, p=0.244) but significant difference for NSM with or without robotic assistance (17/25: 68.0% versus 22/87: 25.3%, p<0.0001). In multivariate analysis, adjusted on previous radiotherapy, ALND, tobacco, cup-size (<C or >C), IBR with implant or dorsi-flap, robotic-NSM, type of mastectomy, significant factors associated with any complication were cup-size >C (OR=2.165, CI 95%=1.07-4.39, p=0.032), LDF-IBR (OR=3.990, CI 95%=2.13-7.46, p<0.0001) and robotic-NSM (OR=3.953, CI 95%=1.37-11.4, p=0.011).

Complications rates grade 2-3-4 were: 10.97% (34/310) for breast and dorsi-flap complications, 10.3% (32/310) for breast complications and 2.0% (2/99) for dorsi-flap complications. Complications rates grade 2-3-4 were: 9.6% (7/73) for muscular latissimus flap without implant, 15.4% (4/26) for muscular latissimus flap with implant, 9.5% (16/169) for definitive-implant and 11.9% (5/42) for expander (non-significant). There was significant difference of complications rates grade 2-3 for NSM with or without robotic assistance (8/25: 32.0 versus 8/87: 9.2%, p=0.008).

Table 4: Median, mean, CI 95%, range results for Post-Operative Hospitalization (POH), time of surgery and anesthesia, mastectomy weight.

		All patients				t-test
		Median	Mean	CI 95%	range	*p*
POH	all	2	2.75	2.56-2.93	1_14	
	implant	2	2.09	1.91-2.27	1_14	0.009
	LDFR	4	4.16	3.89-4.44	2_8	
Time of surgery	all	151	186	175-198	42-495	
	implant	118	130	122-137	42-390	<0.0001
	LDFR	290	304	289-320	158-495	
Time of anesthesia	all	214.5	252	239-264	90-575	
	implant	180	192	183-200	90-563	<0.0001
	LDFR	361	375	359-391	210-575	
Mastectomy weight	all	304	350	327-374	47-1500	
	SSM	334	383	351-415	47-1500	0.007
	NSM	240.5	292	261-322	70-819	
Time of surgery	Robotic	304	317	296-338	127-495	0.028
	non-robotic	127	149	140-158	42-388	
Time of anesthesia	Robotic	382	394	373-415	234-575	0.069
	non-robotic	192	211	201-221	90-447	
Time of surgery	R-LDF	315	326	305-347	190-495	0.003
	nonR-LDF	266	270	252-288	158-388	
Time of anesthesia	R-LDF	386	401	380-422	250-575	0.010
	Non-R-LDF	324.5	335	316-353	210-447	

SSM: Skin Sparing Mastectomy; NSM: Nipple Sparing Mastectomy; LDFR: Latissimus Dorsi-Flap Reconstruction; POH: Post-Operative Hospitalization; R-LDF: Robotic Latissimus Dorsi-Flap

In multivariate analysis, adjusted on previous radiotherapy, ALND, tobacco, cup-size (<C or >C), IBR with implant or dorsi-flap, robotic-NSM, type of mastectomy, significant factor associated with Grade 2-3 complications was robotic-NSM (OR=5.176, CI 95%=1.52-17.6, p=0.008), significant factors associated with Grade 2-3 breast complications were robotic-NSM (OR=5.983, CI 95%=1.72-20.8, p=0.005) and tobacco (OR=2.234, CI 95%=0.95-5.24, p=0.065) and any factor was significantly associated with Grade 2-3 dorsal complications.

Implant loss rate was 4.6% (11/237): 8 definitive implants (8/195: 4.1%) and 3 expander implants (3/42: 7.1%) (non-significant), all without previous radiotherapy.

Post-operative hospitalization

Median POH was 2 days (mean=2.75, CI 95%=2.55-2.93, range=1-14) (Table 4). In univariate analysis, significant criteria associated with POH were ALND, LDF-IBR, indication of mastectomy, BMI, previous radiotherapy, NAC, previous conservative ipsilateral surgery, robotic-NSM. In multivariate analysis, adjusted on ALND, LDF-IBR, indication of mastectomy, BMI, previous radiotherapy, NAC, previous conservative ipsilateral surgery, robotic-NSM, significant factors associated with POH >3-days were LDF-IBR

(OR=21.77, CI 95%=9.83-48.2, p<0.0001) and ILBCR (OR=5.786, CI 95%=1.29-25.9, p=0.022).

Time of surgery and anesthesia (Table 4)

Median time of surgery was 151mn (mean=186, CI 95%=175-198, range=42-495). In univariate analysis, significant criteria associated with time of surgery >180mn were indication of mastectomy, previous radiotherapy, NAC, previous conservative ipsilateral surgery, cup-sizes, LDF-IBR, ALND (bilateral mastectomy: non-significant).In multivariate analysis, adjusted on indication of mastectomy, previous radiotherapy, NAC, previous conservative ipsilateral surgery, cup-sizes, LDF-IBR, ALND and bilateral mastectomy, significant factors associated with time >180mn were cup-size>C (OR=3.581, CI 95%=1.29-9.92, p=0.014), LDF-IBR (OR=779, CI 95%=95.7-6340, p<0.0001) and bilateral mastectomy (OR=9.335, CI 95%=3.10-28.1, p<0.0001).When multivariate analysis was also adjusted on robotic-surgery, robotic procedures was a significant factor associated with time >180mn (OR=42.0, CI 95%=6.69-263, p<0.0001).

Median time of anesthesia was 214.5mn (mean=252, CI 95%=239-264, range=90-575). In univariate analysis, significant criteria associated with time of anesthesia >252mn were indication of mastectomy, previous radiotherapy, NAC, previous conservative ipsilateral surgery, LDF-IBR, ALND, ASA-status, robotic-NSM (bilateral mastectomy: non-significant).In multivariate analysis, adjusted on indication of mastectomy, previous radiotherapy, NAC, previous conservative ipsilateral surgery, LDF-IBR, ALND, ASA-status and bilateral mastectomy, significant factors associated with time >252mn were LDF-IBR (OR=270, CI 95%=69-1058, p<0.0001) and bilateral mastectomy (OR=11.74, CI 95%=3.77-36.5, p<0.0001). When multivariate analysis was also adjusted on robotic-surgery, robotic procedures was a significant factor associated with time >252mn (OR=16.4, CI 95%=3.22-83.7, p=0.001).

Pathologic results, treatment and lipofilling

Median mastectomy weight were 304gr (mean=350, CI 95%=326-374, range=47-1500), 240gr (mean=292, CI 95%=261-322, range=70-819) for NSM and 334gr (mean=383, CI 95%=351-415, range=47-1500) for SSM.

Breast cancer histology were 72 DCIS, 159 ductal invasive-carcinomas, 39 lobular invasive-carcinomas, 3 others invasive-carcinomas and 37 benign tumors.

For invasive BC, adjuvant chemotherapy was done in 35.3% of patients (71/201) and endocrine therapy in 85.6% (174/201). PMRT was realized in 44 cases (30.1%) for invasive-BC (44/146): 22 patients had received radiotherapy after chemotherapy before mastectomy and 33 patients with ILBCR had received radiotherapy. Higher rates of PMRT were reported for patients with implant-IBR in comparison with LDF-IBR (31.2% *vs* 27.0%: 34/109 and 10/37 for invasive carcinomas). Median interval-time between surgery and adjuvant treatment when it was required (77 patients: 24.8%) was 46-days (CI 95%=47.2-57.6, range=23-167), 43-days for adjuvant chemotherapy (CI 95%=42-53, range=23-167) and 63-days for PMRT (CI 95%=59-80, range=35-107) respectively, 45-days for patients without post-operative complications (CI 95%=44.7-56.9, range=23-167) and 51-days for patients with any complication (CI 95%=45.9-66.4, range=32-107) respectively.

Higher rate of interval time >60-days was observed for PMRT (9/17: 52.9%) in comparison with adjuvant chemotherapy (10/60: 16.7%) (p=0.004), without significant difference between patients with or without any complication or complication Grade 2-3.

Lipofilling were performed for 49 patients to June 2018, 28 for implant-IBR (57.1%) and 21 for LDF-IBR (42.9%) with only one procedure in 82.1% of patients with implant-IBR and 42.9% of patients with LDF-IBR. Median fat injection volume was 120cc for implant-IBR (mean=182.5, CI 95%=73-291, range=10-1340) and 417.5cc (mean=384, CI 95%=297-471, range=90-680) for LDF-IBR.

Discussion

Our study includes a large amount of patients, even if it is a monocentric study. We offer various surgical techniques, even though we do not perform microsurgery, DIEP and loco-regional or perforator based flaps. The limit of our study is the lack of cosmetic assessment in association of quality of life.

Rate of NSM

We reported a high rate of NSM for BC during this recent period (30.4%: 83/273) including 23.8% of NSM for ILBCR (20/84). Autologous-IBR was the procedure preferred for patients with irradiated skin flaps (51/67: 76.1%), as reported by Berry et al., [15], associated with secondary lipofilling in order to obtain sufficient breast volume. For patients who had lipofilling before June 2018, a high fat injection volume was allowed (median=417.5cc).

Rate of robotic surgery

Robotic breast-surgery was proposed since February 2016, in 13.3% (19/143) during year-2016 and 28.7% (48/167) during year-2017: 25robotic-NSM, 42robotic-LDF and 18robotic-NSM with concomitant robotic-LDF. Sixty-six per-cents (60/99) of LDF were performed with robotic-surgery, without any dorsal scar through axillar incision for NSM and through incision of NAC resection for SSM [4].

Only few cases were reported in literature studies for prophylactic NSM [5] or some cases of BC [8,10] and for LDF-IBR [4,9]. In relation with our beginning experience with robotic breast-surgery, we reported higher times of procedures in comparison with non-robotic-surgery. However, with learning curve we have reported a decrease of time for these robotic procedures in previous studies [11] as reported by Lai et al., [10].

Rate of LDF

IBR was realized with LDF in 31.9% of patients (99/310) including 64.4% (29/45) of LDF-IBR for ILBCR and 76.1% (51/67) of IBR after previous radiotherapy for ILBCR or mastectomy after chemotherapy and radiotherapy. Consequently, LDF-IBR for primary BC was 23.2% (48/207). An implant was associated with LDF for 26 patients (26.3%) with cup-size >C in 9 cases and mastectomy weight >300gr in 20 cases. We reported an increase of LDF-IBR in year 2017 in comparison with 2016 (41/102: 40.2% *vs* 58/109: 53.2%). In our study, factors significantly associated with LDF-IBR were high BMI and previous radiotherapy and/or NAC. All IBR for bilateral mastectomy were performed with implant.

Complications

The overall complication rate was 31.9%, quite similar with

others studies: 49% in Pinsolle et al study [16] with 266 IBR, 45% in the prospective study reported by Alderman et al., [17] with 326 IBR mainly with TRAM (76%), 31.8% in Berry et al study [15] with 1037 IBR, 62% in Contant et al., study [18] and 55% in Ducic et al., study for TRAM-IBR [19]. However, complications rates are difficult to compare with others studies in reason with great disparities of IBR types, complications recorded, different indications of mastectomy and time of survey.

In recent studies with IBR and NSM, complications rates reported was lesser: 5.1% (6/117) in Corso et al., study [20], 18% for NSM (40/219) in Romanoff et al., study [21], 20% in Headon et al., [22] pooled analysis of 12,358 NSM with a nipple necrosis rate of 5.9%. In a recent review of 3716 prophylactic-NSM [23] the average overall complication rate was 20.5%, the average NACx necrosis was 8.1% and 7.1% for the cutaneous skin flaps.

Even use of pre-operative antimicrobial therapy for patients with nasal-germs and per-operative antimicrobial-prophylaxis we reported a 4.1% rate of implant loss mainly in relation with infectious complication. However, this rate was lesser than rates reported by others [16,17].

In our study, overall complication rate was lesser for LDF-IBR (24.7%) and implant-IBR (20.9%) than LDF with implant-IBR (34.6%) but non-significant. However, in a retrospective study with 12,129 patients operated between 2005-2011, autologous-flap-IBR was associated with higher complication rate in comparison with breast-implant-IBR (OR=1.41 in multivariate analysis) [24]. Dorsal seroma rate was 39.4% similar to the rate of 35% reported by Pinsolle et al., [16].

Major complications rate, grade 3-4 with re-operation and/or re-hospitalization, was 9.35% (29/310) in our study, lesser than reported rates in others studies (11-37%) [17,18,25-27] but with different IBR procedures, different criteria of complications recorded and different time of survey in reported studies. Except 2 cases of re-operation for dorsal bleeding, all 27 grade 3-4 complications were in relation with mastectomy. In the large NMBRA-cohort [28] with 3389 IBR this rate was 15.8% with 3-months of follow-up. Grade 2-3-4 complications rate were 10% for implant-IBR, 9.7% for LDF-IBR and 15.4% for LDF with implant-IBR (non-significant) in our study.

Complications and previous radiotherapy: In our study, 76.1% of patients had LDF-IBR with or without implant. Complications rate were 20.9% for implant-IBR (44/211) and 55.6% for LDF-IBR (55/99). In multivariate analysis, previous radiotherapy was not-significantly associated with overall complication and Grade 2-3-4 complications. However, Krueger et al., [29] reported higher complication rate with previous radiotherapy in comparison with no radiotherapy for implant-IBR (68% *vs* 31%; p=0.006) and Berry et al., [15] reported higher major-complication rate (OR=2.7 [1.5 - 4.9]) with previous radiotherapy, with lesser complications for flap-IBR in comparison with implant-IBR (p=0,005; OR=0.22).

Complications and tobacco: In our study, Grade 2-3-4 complication rate was significantly associated with tobacco (OR=2.234). Two studies reported higher failure IBR rate for patients with tobacco use [30,31]. The risk of flap necrosis was increase by tobacco [32-34] and infection rate was also increase in several studies [19,31,34].

Complications, time of surgery, anesthesia and robotic surgery: Overall complication rates for LDF-IBR, robotic or non-robotic were not-significantly different (26/60: 43.3% versus 15/39: 38.5%) and grade 3 complication rates were also not different (1.7% versus 2.6%). In multivariate analysis, time of surgery and anesthesia were higher for robotic procedures in comparison with non-robotic procedures. We observed in other study a decrease of time of anesthesia and surgery according to learning curve [11] and we hope that increase experience of robotic breast-surgery allowed non-significant times of procedures in the next years.

Post-operative hospitalization: In our study median POH was low (2 days, mean: 2.75) with significant higher POH for patients with LDF-IBR and IBR for ILBCR in multivariate analysis. In Offodile et al., study [35], Enhanced Recovery After Surgery (ERAS) significantly reduces length of stay (-1.58, p<0.00001) in comparison with traditional care. However, length of stay in eight studies with 1151 patients was higher, even for ERAS (1 to 6.2 mean days, > 3 days for 5 studies). Complications rates were not different between ERAS and traditional care, but ERAS significantly reduces opioid use. We think that ERAS for IBR could be contributive for lesser length of stay, particularly for flap-IBR, for pain control and quicker recovery. In our practice, opioid use was also decrease in relation with local anesthesia before incision (paravertebral bloc or pectoral bloc). We have started an ERAS program from several years for colo-rectal, urologic and gynecologic oncological surgery in our institution and planed an ERAS program for IBR in next months.

Interval time between surgery and adjuvant chemotherapy or PMRT was not different for patients with or without post-operative complications. IBR seems not to be a reason for delayed adjuvant treatment.

Conclusion

We reported a high rate of IBR for primary BC and ILBCR with a high rate of NSM (36.1%) and an increase of LDF-IBR in year 2017 in comparison with 2016 (41/102: 40.2% *vs* 58/109: 53.2%). LDF-IBR for ILBCR was the preferred procedure, realized in 64.4% of cases. Robotic LDF-IBR without dorsal scar was realized in 60.6% (60/99) of patients with a low complication rate.

We reported short post-operative hospitalization stay (median: 2 days) but we think that ERAS program could decreased this length of stay. We hope to confirm these results with practice evolution analysis during year-2018.

References

1. Dauplat J, Kwiatkowski F, Rouanet P, Delay E, Clough K, Verhaeghe JL, et al. Quality of life after mastectomy with or without immediate breast reconstruction. Br J Surg. 2017;104:1197-1206.

2. Matsen CB, Mehrara B, Eaton A, Capko D, Berg A, Stempel M, et al. Skin flap necrosis after mastectomy with reconstruction: a prospective study. Ann SurgOncol. 2016; 23:257-264.

3. Offodile AC, Lee CN. Future Directions for Breast Reconstruction on the 20th Anniversary of the Women's Health and Cancer Rights Act. JAMA Surg. 2018; 153:605-606.

4. Pacelli J, Sharifzadehgan S, Rua S, Houvenaeghel G, Ngo C, Bats AS, et al. Robotic-assisted latissimus dorsi muscle harvest for immediate breast

reconstruction. GynecolObstetFertilSenol. 2018;46:744-746.

5. Sarfati B, Struk S, Leymarie N, Honart JF, Alkhashnam H, Tran de Fremicourt K, et al. Robotic Prophylactic Nipple-Sparing Mastectomy with Immediate Prosthetic Breast Reconstruction: A Prospective Study. Ann SurgOncol. 2018;25:2579-2586.

6. Sarfati B, Struk S, Leymarie N, Honart JF, Alkhashnam H, Kolb F, et al. Robotic Nipple-Sparing Mastectomy with Immediate Prosthetic Breast Reconstruction: Surgical Technique. PlastReconstr Surg. 2018;142:624-627.

7. Struk S, Qassemyar Q, Leymarie N, Honart JF, Alkhashnam H, De Fremicourt K, et al. The ongoing emergence of robotics in plastic and reconstructive surgery. Ann ChirPlastEsthet. 2018;63:105-112.

8. Toesca A, Peradze N, Galimberti V, Manconi A, Intra M, Gentilini O, et al. Robotic Nipple-sparing Mastectomy and Immediate Breast Reconstruction With Implant: First Report of Surgical Technique. Ann Surg. 2017;266:e28-e30.

9. Lai HW, Lin SL, Chen ST, Lin YL, Chen DR, Pai SS, et al. Robotic nipple sparing mastectomy and immediate breast reconstruction with robotic latissimus dorsi flap harvest - Technique and preliminary results. J PlastReconstrAesthet Surg. 2018;71:e59-e61.

10. Lai HW, Wang CC, Lai YC, Chen CJ, Lin SL, Chen ST, et al. The learning curve of robotic nipple sparing mastectomy for breast cancer: An analysis of consecutive 39 procedures with cumulative sum plot. Eur J SurgOncol. 2019; 45: 125-133.

11. Houvenaeghel G, Bannier M, Rua S, Barrou J, Heinemann M, Van Troy A, et al. Breast cancer robotic nipple sparing mastectomy: evaluation of several surgical procedures and learning curve. WJSO 2019 in press.

12. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240: 205-213.

13. Zinzindohoué C, Bertrand P, Michel A, Monrigal E, Miramand B, Sterckers N, et al. A Prospective Study on Skin-Sparing Mastectomy for Immediate Breast Reconstruction with Latissimus Dorsi Flap After Neoadjuvant Chemotherapy and Radiotherapy in Invasive Breast Carcinoma. Ann SurgOncol. 2016;23:2350-2356.

14. Barrou J, Bannier M, Cohen M, Lambaudie E, Gonçalves A, Bertrand P, et al. Pathological complete response in invasive breast cancer treated by skin sparing mastectomy and immediate reconstruction following neoadjuvant chemotherapy and radiation therapy: Comparison between immunohistochemical subtypes. Breast. 2017;32:37-43.

15. Berry T, Brooks S, Sydow N, Djohan R, Nutter B, Lyons J, et al. Complication rates of radiation on tissue expander and autologous tissue breast reconstruction. AnnSurgOncol. 2010; 17: 202-210.

16. Pinsolle V, Grinfeder C, Mathoulin-Pelissier S, Faucher A. Complications analysis of 266 immediate breast reconstructions. J PlastReconstr Aesthetic Surg. JPRAS. 2006; 59: 1017-1024.

17. Alderman AK, Wilkins EG, Kim HM, Lowery JC. Complications in postmastectomy breast reconstruction: two-year results of the Michigan Breast Reconstruction Outcome Study. PlastReconstr Surg. 2002; 109: 2265-2274.

18. Contant CM, van Geel AN, van der Holt B, Griep C, Tjong Joe Wai R, Wiggers T. Morbidity of immediate breast reconstruction (IBR) after mastectomy by a subpectorally placed silicone prosthesis: the adverse effect of radiotherapy. Eur J SurgOncol. JEurSocSurgOncol Br AssocSurgOncol. 2000; 26: 344-350.

19. Ducic I, Spear SL, CuocoF, Hannan C. Safety and risk factors for breast reconstruction with pedicled transverse rectus abdominis musculocutaneous flaps: a 10-year analysis. Ann PlastSurg. 2005; 55: 559-564.

20. Corso G, De Lorenzi F, Vicini E, Pagani G, Veronesi P, Sargenti M, et al. Nipple-sparing mastectomy with different approaches: surgical incisions, complications, and cosmetic results. Preliminary results of 100 consecutive patients at a single center. Journal of Plastic, Reconstructive & Aesthetic Surgery. 2018; 71: 1751-1760.

21. Romanoff A, Zabor EC, Stempel M, Sacchini V, Pusic A, Morrow M. A Comparison of Patient-Reported Outcomes After Nipple-Sparing Mastectomy and Conventional Mastectomy with Reconstruction. Ann SurgOncol. 2018; 25:2909-2916.

22. Headon HL, Kasem A, Mokbel K. The oncological safety of nipple-sparing mastectomy: a systematic review of the literature with a pooled analysis of 12,358 procedures. Arch Plast Surg. 2016; 43:328e38.

23. Muller T, Baratte A, Bruant-Rodier C, Bodin F, Mathelin C. Oncological safety of nipple-sparing prophylactic mastectomy: A review of the literature on 3716 cases. Ann ChirPlastEsthet. 2017; S0294-1260; 30137-30141.

24. Fischer JP, Wes AM, Tuggle CT, Serletti JM, Wu LC. Risk Analysis and Stratification of Surgical Morbidity after Immediate Breast Reconstruction. J Am Coll Surg. 2013; 217: 780-787.

25. Seth AK, Hirsch EM, Fine NA, Dumanian GA, Mustoe TA, Galiano RD, et al. Additive risk of tumescent technique in patients undergoing mastectomy with immediate reconstruction. Ann SurgOncol. 2011; 18: 3041-3046.

26. Rusby JE, Waters RA, Nightingale PG, England DW.Immediate breast reconstruction after mastectomy: what are the long-term prospects? Ann RCollSurg Engl. 2010; 92: 193-197.

27. CloughKB, O'Donoghue JM, Fitoussi AD, NosC, Falcou MC. Prospective evaluation of late cosmetic results following breast reconstruction: I. Implant reconstruction. PlastReconstr Surg. 2001; 107: 1702-1709.

28. National mastectomy and breast reconstruction audit - third annual report. 2010.

29. Krueger EA, Wilkins EG, Strawderman M, Cederna P, Goldfarb S, Vicini FA, et al. Complications and patient satisfaction following expander/implant breast reconstruction with and without radiotherapy. Int J RadiatOncolBiol Phys. 2001; 49:713-721.

30. McCarthy CM, Mehrara BJ, Riedel E, Davidge K, Hinson A, Disa JJ, et al. Predicting complications following expander/implant breast reconstruction: an outcomes analysis based on preoperative clinical risk. PlastReconstr Surg. 2008; 121: 1886-1892.

31. Petersen A, Eftekhari ALB, DamsgaardTE. Immediate breast reconstruction: A retrospective study with emphasis on complications and risk factors. JPlastSurg Hand Surg. 2012; 46: 344-348.

32. Albino FP, Koltz PF, LingMN, LangsteinHN. Irradiated autologous breast reconstructions: effects of patient factors and treatment variables. Plast Reconstr Surg. 2010; 126: 12-16.

33. Chang DW, Reece GP, Wang B, Robb GL, Miller MJ, Evans GR, et al. Effect of smoking on complications in patients undergoing free TRAM flap breast reconstruction. PlastReconstr Surg. 2000; 105: 2374-2380.

34. Vega S, Smartt JM Jr, Jiang S, Selber JC, Brooks CJ, Herrera HR, Serletti JM. 500 Consecutive patients with free TRAM flap breast reconstruction: a single surgeon's experience. PlastReconstr Surg. 2000; 122: 329-339.

35. Offodile AC, Gu C, Boukovalas S, Coroneos CJ, Chatterjee A, Largo RD, Butler C. Enhanced recovery after surgery (ERAS) pathways in breast reconstruction: systematic review and meta-analysis of the literature. Breast Cancer Res Treat. 2018.