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Research Article

Robotic Latissimus Dorsi-Flap Breast Reconstruction: 101 Procedures in 30 Months

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2. Key words

Robotic; Breast cancer; Latissimus dorsi-flap; Breast reconstruction ; Surgery

1. Abstract

1.1. Aims: Few cases of Robotic Latissimus Dorsi-Flap Reconstruction (RLDFR) were reported. We describe our experience of RLDFR and analyze techniques, indications and reproducibility.

1.2. Methods: We determined characteristics of patients, previous treatment, primitive Breast Cancer (BC) or recurrence, type of mastectomy (SSM Skin-Sparing or NSM Nipple-Sparing Mastectomy), type of reconstruction (RLDFR with or without implant), durations of anesthesia, surgery and hospitalization stay, complications and re-operation rates. Three periods was determined.

1.3. Results: RLDFR were performed in 101 patients during a study period of 30 months: 63 with autologous RLDF (muscle and fat around muscle) and 38 with non-autologous RLDF (only muscle flap) associated with breast implant respectively in 12 and 20 patients. Previous radiotherapy had been performed in 22 local recurrences and 14 primary BC.

Reconstruction with implant (versus without implant) was significantly associated with mastectomy weight >330gm (OR=8.8), periods P2 (OR=0.156) and P3 (OR=0.051) and reconstruction with versus without autologous RLDF was significantly associated with neo-adjuvant chemotherapy and radiotherapy before surgery (OR=0.065).

Significant factors of time of surgery ≥305mn were: SSM (OR=0.239), autologous RLDF without implant (OR=0.204) versus non autologous RLDF without implant, periods P2 (OR=0.047) and P3 (OR=0.027).

Median time of hospitalization was 4 days. Complications related to RLDF were: 30 grade 1 (dorsal seroma) and 1 grade 3 (re-operation for dorsal bleeding).

1.4. Conclusion: RLDFR appeared as a reproducible and safe procedure with a single incision. An increased of autologous RLDFR was observed according to patient's and surgeon's choice. This technique seems contributive, particularly in cases of previous radiotherapy.

3. Introduction

The Latissimus Dorsi-muscle Flap (LDF) was one of the first methods proposed for breast reconstruction. Implant breast reconstruction remained the more frequent method used (46.5% in a French study) [1] with recently development of Immediate Breast Reconstruction (IBR) with implant associated with a cellular matricesor synthetic meshes. Myo-cutaneous flap with dorsi-muscle or rectus abdominal muscle has been frequently used during last years. However, myo-cutaneous rectus abdominal flap has been replaced with free-flaps, particularly with the development of Deep Inferior Epigastric Artery Perforator (DIEP).

The relative simplicity of LDF coupled with the very reliable and consistent vascularity of the flap has increased its use. In the French multicentric study [1] LDF was frequently used for IBR

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(46.9%). The traditional open technique requires a posterior donor site incision with a length of 15-30 cm. Endoscopic LDF has been proposed and realized in some centers [2-11]. However, because of the two-dimensional view and the nonflexible instruments, this procedure is not easy. More recently, robotic LDF reconstruction (RLDFR) has been described [12, 13] but very few cases were reported in indication of breast reconstruction for Breast Cancer (BC): 3 patients with Nipple Sparing Mastectomy (NSM) for IBR and 2 patients for delayed reconstruction after tissue expander and radiotherapy in Selber et al study in 2012 [12], 17 patients for delay-immediate reconstruction after Skin Sparing Mastectomy (SSM) with tissue expander in Clemens et al study in 2014 [14], 3 patients for delayed reconstruction following tissue expander in- sertion or breast conserving surgery and 4 patients for IBR and NSM in Chung et al study in 2015 [15] and finally, 2 patients for IBR and robotic NSM in Lai et al study in 2018 [16].

With our experience of robotic surgery since January 2007 in gynecologic oncology, we decided to develop robotic breast surgery and RLDFR. The purpose of this study is to describe our institutional experience of RLDFR and to analyze techniques used, indications and reproducibility.

4. Material Methods

All patients during 30 months (January 2016 to June 2018) with RLDFR were analyzed. All patients were informed of surgery with robotic assistance. This study protocol was approved by our institutional ethical committee with analysis of Institutional Breast Cancer Database: NCT02869607. The data reported in the current analysis also include the patient data reported in the earlier publications [17, 19].

We determined characteristics of patients (age, Body Mass Index (BMI), tobacco use, diabetes, ASA status (American Society of Anesthesiologists score), breast volume, previous treatment for Breast Cancer (BC) (Sentinel Lymph Node Biopsy (SLNB), Axillary Lymph Node Dissection (ALND), neo-adjuvant chemotherapy, previous breast radiotherapy, primary or recurrent BC, type of reconstruction (LDFR with or without breast implant, "autologous LDF" muscle and fat around muscle with bigger volume in comparison with "non-autologous LDF" which is only muscle flap without fat around muscle), complication rate with Clavien Dindo grading [20], re-operation rate, type of complication and numbers of post-operative hospitalization days. Skin Sparing Mastectomy (SSM) was proposed for patients who want an IBR for whom NSM was not indicated (Nipple Areolar Complex (NACx) involvement or tumor-NAC distance <2 centimeters).

Surgical technic with type of *da Vinci Si* ® Surgical system, number of trocars, skin incision, duration of anesthesia and surgery were reported according to period of treatment and association of surgical procedures (breast implant, LDFR, ALND and contra-lateral breast surgery). Duration of anesthesia was recorded from anesthesia induction to tracheal extubation and duration of surgery included all procedures and the times for changing surgical postures, from skin incision to the end of skin suture. Three periods was determined: P1 (year 2016), P2 (year 2017) and P3 (year 2018: January to June).

4.1. Surgery

(Figures 1-3) The anterior border of the LD muscle and the inferior mammary fold were designed and marked before incision. Incision around NACx was performed for SSM and R-LDF dissection was performed in 34 patients through this incision and in 54 patients through a short axillar incision (5-6 cm, according to breast volume) for 50 NSM and 5 SSM (Table 1). Axillary surgery (axillary lymph node dissection or sentinel lymph node biopsy) was performed through the same incision.

The beginning of the dissection for sub-cutaneous plan of LD muscle and a limited dissection under along anterior axillary line about 6-7cm under axillar basin (at the inferior mammary fold level) in order to introduced one robotic trocar (8mm) were performed. Then, a *Gelpoint*® Path mono-trocar was introduced through the incision with 2 robotic trocars and 1 trocar for *Airseal*® device insufflation also used for the assistant surgeon when necessary. We used a low pressure (7mm). Depending of the breast side (49 right, 52 left), we introduced a monopolar scissors and bipolar clamp into up and down robotic trocars with 0° camera in the middle robotic trocar.

Robotic surgery started with superficial dissection of LD muscle from middle of the muscle to inferior part (5-6 centimeters under inferior mammary fold) and to superior part with a total section of tendinous insertion. Then, we performed dissection under LD muscle from the middle to inferior part and to the level of arterial venous pedicle. Section of LD muscle was performed with monopolar scissors for posterior dorsal insertions, then at the inferior part of dissection, with progressive mobilization of muscle. The LDF was fixed over each quadrant with about 6 sutures between LDF and thoracic wall through the axillary incision without use of da Vinci. When implant was used, we performed coverage of sub pectoral implant with LDF and in some cases we used the two muscles, pectoral and LDF, to achieved complete implant coverage. Two drains were placed through the inferior infra-centimetric scar

Figure 1: Skin sparing mastectomy with disposition of Gel point device through resection of nipple areolar complex.

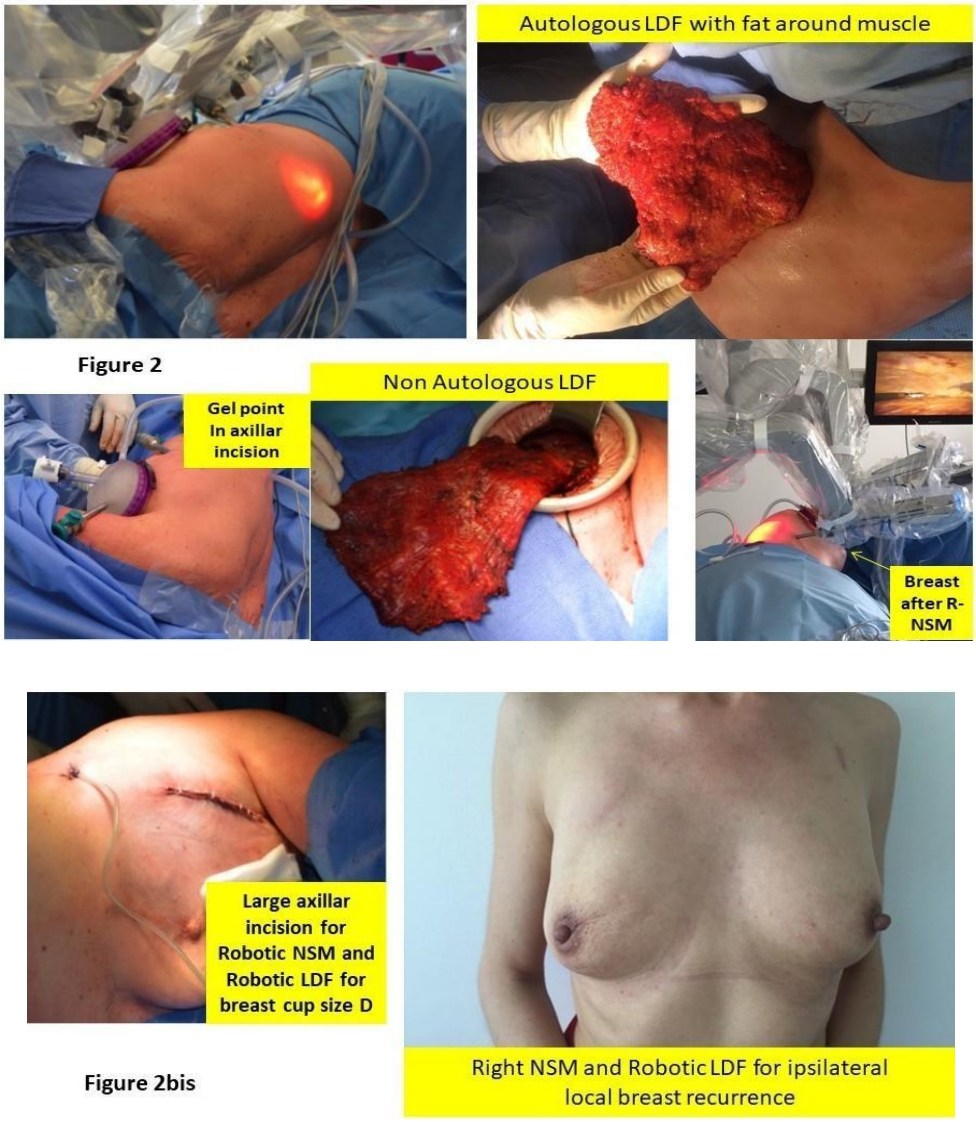

Figure 2 and 2bis: Nipple sparing mastectomy with disposition of Gel point through axillar incision. Autologous and non-autologous latissimus dorsi-flap.

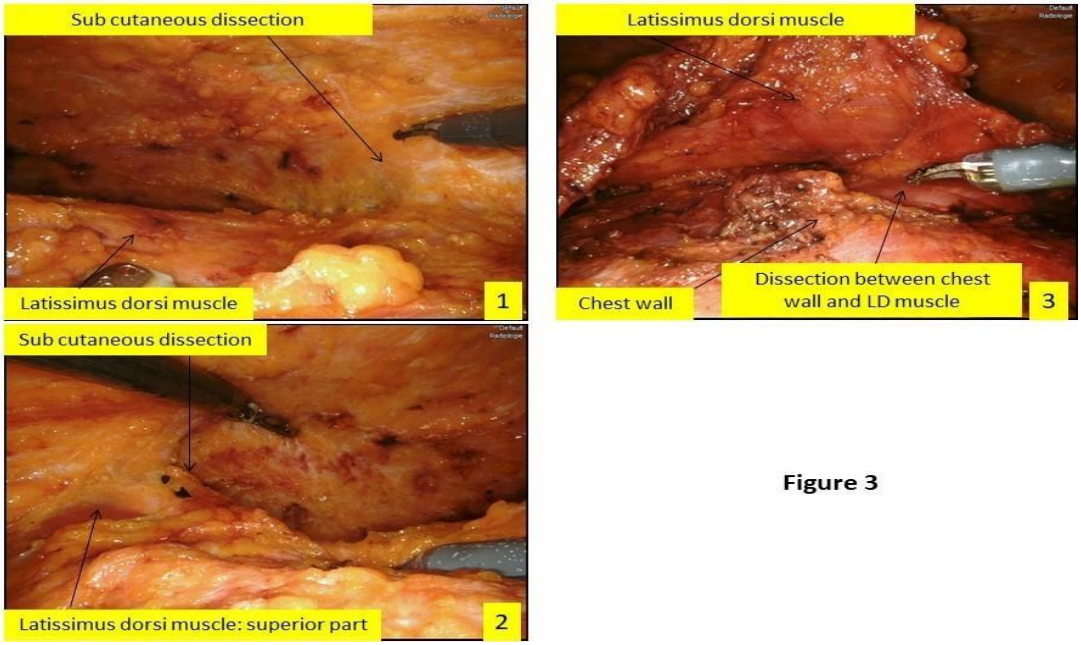

Figure 3: Views of robotic latissimus dorsi-flap.

for dorsal area and one for mastectomy.

4.2. Statistics

Main characteristics were reported with median, mean, confident interval 95% (CI95) for quantitative criteria. Comparisons were performed using Chi2, t-test and logistic binary regression with SPSS 16.0.

5. Results

During the study period, 101 patients were operated with RLD-FR with da Vinci robot (Intuitive Surgical, Sunnyvale, CA, USA) by three surgeons. Number of patients was 23, 47 and 31 respectively for periods P1 to P3. Chest wall sizes were: ≤85, 90, 95, 100 and >100centimeters, respectively in 15, 29, 41, 10 and 6 patients.

Table 1: Characteristics of all patients and according to type of reconstruction.

Characteristics of patients are reported in (Table 1)**.**

Robotic breast surgery was offered in selected cases during the study period: 13 delayed breast reconstructions with RLDF (DBR) and 88 RLDF for IBR (39 SS Mand 49NSM) among 424 IBR (20.7%)

and among 1152 patients who required a total mastectomy (7.6%). Among 49 NSM with IBR, 33 (67.3%) were performed with robotic procedure in the same time. During the study period, 13 NSM with implant only IBR were performed including 11 robotic NSM.

Robotic procedures were performed using **Si** system in 46 patients and **Xi** system in 55 patients, 3 robotic operative arms for 21 patients and 2 robotic operative arms for 80 patients (79.2%) with also in all cases 1 arm for the 0 degree scope: 3 arms 14/23

Population		All patients		RLDF non autologous		Autologous RLDF		RLDF+implant		Autologous RLDF+implant		Chi 2
		Nb	%	Nb	%	Nb	%	Nb	%	Nb	%	p
All patients		101		18	17.8	51	50.5	20	19.8	12	11.9	
IBR / DBR	IBR	88	87.1	18	100	41	80.4	19	95	10	83.3	0.112
	DBR	13	12.9	0	0	10	19.6	1	5	2	16.7	
Mastectomy	NSM	50	49.5	13	72.2	24	47.1	10	50	3	25	0.12
	SSM	39	38.6	5	27.8	18	35.3	9	45	7	58.3	
	Standard	12	11.9	0	0	9	17.6	1	5	2	16.7	
indication	primitive BC	75	74.3	14	77.8	38	74.5	16	80	7	58.3	0.789
	local recurrence	25	24.8	4	22.2	12	23.5	4	20	5	41.7	
	prophylactic	1	0.9	0	0	1	2	0	0	0	0	
incision	axillar	54	53.5	14	77.8	27	52.9	12	60	1	8.3	**<0.01**
	areolar	34	33.6	4	22.2	15	29.4	7	35	8	66.7	
	previousscar	13	12.9	0	0	9	17.6	1	5	3	25	

Robot system	SI	46	45.5	3	16.7	20	39.2	14	70	9	75	**0.001**
	XI	55	54.5	15	83.3	31	60.8	6	30	3	25	
age	<= 50 years	39	38.6	7	38.9	22	43.1	8	40	2	16.7	0.408
	> 50 years	62	61.4	11	61.1	29	56.9	12	60	10	83.3	
Mastectomy weight	<= 330 gr	47	47	14	77.8	26	52	6	30	1	8.3	**0.001**
	> 330 gr	53	53	4	22.2	24	48	14	70	11	91.7	
Periods	P1	23	22.8	1	5.6	8	15.7	7	35	7	58.3	**<0.0001**
	P2	47	46.5	3	16.7	30	58.8	12	60	2	16.7	
	P3	31	30.7	14	77.8	13	25.5	1	5	3	25	
BMI	< 23.5	53	52.5	14	77.8	26	51	7	35	6	50	0.067
	≥ 23.5	48	47.5	4	22.2	25	49	13	65	6	50	
Radiotherapy	No	40	39.6	4	22.2	24	47.1	7	35	5	41.7	**0.002**
	PMRT	17	16.8	6	33.3	9	17.6	1	5	1	8.3	
	previous RTH	30	29.7	4	22.2	16	31.4	4	20	6	50	
	previous NAC+RTH	14	13.9	4	22.2	2	3.9	8	40	0	0	
Cup size	A-B	48	47.5	14	77.8	27	52.9	5	25	2	16.7	**<0.01**
	C	33	32.7	3	16.7	17	33.3	7	35	6	50	
	D-E-F	20	19.8	1	5.5	7	13.7	8	40	4	33.3	
Duration of surgery	< 305 min	56	55.4	8	44.4	36	70.6	7	35	5	41.7	**0.019**
	≥ 305 min	45	44.6	10	55.6	15	29.4	13	65	7	58.3	
Hospitalization stay	< 4 days	39	38.5	9	50	24	47.1	5	25	1	8.3	**0.033**
	≥ 4 days	62	61.4	9	50	27	52.9	15	75	11	91.7	
Complications RLDF	No	70	69.3	14	77.8	36	70.6	12	60	8	66.7	0.532
	Grade 1	30	29.7	4	22.2	15	29.4	7	35	4	33.3	
	Grade 3	1	1	0	0	0	0	1	5	0	0	
Complications Patients	No	54	53.5	12	66.7	29	56.9	6	30	7	58.3	0.261
	Grade 1	31	30.7	4	22.2	14	27.5	10	50	3	25	
	Grade 2	5	5	1	5.6	4	7.8	0	0	0	0	
	Grade 3	11	10.9	1	5.6	4	7.8	4	20	2	18.2	
Implant loss		3	9.4					3	15	0	0	0.23
Histology BC	DCIS	23	23	3	16.7	11	23.9	4	22.2	0	0	
	Invasive	77	77	15		35		14		11		
Previous breast surgery	No	57	56.4	12	66.7	31	60.8	12	60	2	16.7	**0.03**
	Yes	44	43.6	6	33.3	20	39.2	8	40	10	83.3	
installation	in side only	14	13.9	4	22.2	8	15.7	2	10	0	0	0.62
	dorsal + in side	87	86.1	14	77.8	43	84.3	18	90	12	100	

Abbreviations: IBR : Immediate Breast Reconstruction, DBR : Delayed Breast Reconstruction, BMI : Body Mass Index, RLDF: Robotic Latissimus Dorsi-Flap, BC: Breast Cancer, Autologous RLDF : RLDF with fat around muscle, RLDF non autologous : RLDF without fat around muscle, NAC: Neo-Adjuvant Chemotherapy, RTH: Radiotherapy

(60.9%) during 2016, 7/47 (14.9%) during 2017 and 0/31 during 2018 ($p<0.0001$).

Axillary surgery was performed concomitantly in 46 cases (29 SLNB and 17 ALND) and a contra-lateral breast surgery was performed during the same time in 7 (6.9%) patients.

5.1. Indications and Type of Reconstruction

RLDFR with breast implant was performed in 31.7% of patients (32/101) (Table 1), in 56.3% (18/32) after previous radiotherapy. Breast reconstruction was performed in 63 patients with "autologous LDF" associated with breast implant in 12 patients (19%: 12/63) and in 38 patients with "non-autologous LDF" associated with breast implant in 20 patients (52.6%: 20/38). Median implant breast volume was 340cc (range: 105-490), respectively 320cc (225-380) and 340cc (105-490) for autologous and non-autologous RLDF. Median mastectomy weight was 327.5 gm with differences between different reconstructions types (Table 2 & Table 2 bis).

Mastectomies were performed for 25 local BC recurrences, 75 primary BC and 1 prophylactic mastectomy: 23 Ductal Carcinomas In Situ (DCIS) and 77 invasive BC. Previous radiotherapy had been performed in 22 local BC recurrences and 14 primitive BC with chemotherapy and radiotherapy before mastectomy with IBR.

In univariate analysis, type of reconstruction was significantly different according to, 3 periods, radiotherapy, previous homo-lateral

breast surgery, breast cup size, mastectomy weight, robot system used and type of incision (Table 1). Others factors were not significant. Results according to IBR versus Delayed Breast Reconstruction (DBR), RLDF with or without implant and RLDF autologous or not are reported in (Table 2&Table 2bis).

In univariate analysis, type of reconstruction with or without implant was significantly associated with incision (0.018), number of trocar used (0.001), type of robot (<0.0001), number of surgical procedures (<0.0001), mastectomy weight (<0.0001), cup size (0.003), periods (0.001) (Table 1).

In binary logistic regression, type of reconstruction with implant (versus without implant) was significantly associated with mastectomy weight >330gm (OR: 8.8) and periods P2 (OR: 0.156) and P3 (OR: 0.051) (Table 3).

In binary logistic regression, type of reconstruction with versus without autologous RLDF was significantly associated with neo-adjuvant chemotherapy and radiotherapy before surgery (OR: 0.065) (Table 3).

5.2. Durations of Surgery

Median surgery time was 300 minutes (Table 2). In univariate analysis, time of surgery was significantly different according to autologous LDF or not (0.011), implant or not (0.012), periods (<0.0001), robot system used (0.002), number of trocar (<0.0001), incision (0.002), type of mastectomy (0.058), type of reconstruction (0.019). Others factors were non-significant: incision, BMI, surgeon, age, mastectomy weight, cup size, number of surgical procedures, contra lateral surgery, radiotherapy, breast side, DBR/IBR. A strong correlation between type of incision and type of mastectomy was observed (p<0.001).

In binary logistic regression significant factors of time of surgery

Table 2: Means comparisons according to types of reconstruction.

		All patients	RLDF non autologous	RLDF Autologous	RLDF implant	Autologous RLDF implant
age	median	54	54.5	52	53	64.5
	mean	55	53.4	54.1	54.8	62.1
	CI 95%	52.5-57.6	47.1-59.7	50.3-57.9	48.7-60.9	56.2-68.0
	Range	21-83	29-73	21-83	34-76	45-72
BMI	median	23.4	21.7	23.6	24.6	23.5
	mean	24.4	22.4	24.7	25.7	24.2
	CI 95%	23.6-25.3	21.0-23.8	23.4-26.1	24.1-27.2	22.2-26.3
	Range	18.1-38.0	19.7-31.1	18.1-38.0	20.3-32.2	19.5-28.7
Mastectomy weight	median	327.5	248.5	300	465	507.5
	mean	390	287.8	375.7	444	533
	CI 95%	336-444	209-366	275-476	369-519	409-656
	Range	72-1600	72-676	80-1600	201-695	263-800
Duration of surgery	median	300	309.5	280	354.5	312.5
	mean	309	306	289	349	332
	CI 95%	294-324	282-330	268-309	306-392	292-371
	Range	166-495	219-398	166-474	190-495	270-495
Post-operative stay	median	4	3.5	4	5	5
	mean	4.05	3.5	3.78	4.55	5.17
	CI 95%	3.76-4.34	3.04-3.96	3.40-4.17	3.83-5.27	4.16-6.17
	Range	2.0-8.0	2.0-6.0	2.0-7.0	2.0-8.0	2.0-8.0

Abbreviations : BMI : Body Mass Index, RLDF: Robotic Latissimus Dorsi-Flap

Table 2 bis : Means comparisons according to types of reconstruction.

		IBR	DBR	t-test p	without implant	with implant	t-test p	autologous	non autologous	t-test p
age	median	54	51	0.584	52.5	61	0.193	55.5	53.5	0.573
	mean	55.3	53.2		54.06	57.5		55.8	54.1	
	CI 95%	52.6-58.1	45.5-60.9		50.9-57.3	53.2-61.9		52.5-59.1	49.9-58.3	
	Range	21-83	29-71		21-83	34-76		21-83	29-76	
BMI	median	23.3	24.4	0.426	23	24.2	0.265	23.5	23.44	0.548
	mean	24.3	25.4		24.1	25.1		24.6	24.1	
	CI 95%	23.4-25.2	22.8-27.9		23.1-25.2	23.9-26.3		23.5-25.8	23.0-25.3	
	Range	18.1-38.0	19.5-35.4		18.1-38.0	19.5-32.2		18.1-38.05	19.7-32.2	

Mastectomy weight	median	327.5	556	**0.011**	302	501.5	**0.046**	356.5	325	0.282
	mean	390	589		379	488.5		435.9	379	
	CI 95%	336-444	460-719		311-448	429-548		362-510	318-439	
	Range	72-1600	250-930		72-1600	201-800		80-1600	72-780	
Duration of surgery	median	300	280	**0.024**	287.5	332	**0.002**	290.5	330	**0.037**
	mean	315	265		294	343		298	329	
	CI 95%	299-332	236-294		278-311	313-372		280-316	304-354	
	Range	190-495	166-330		166-474	190-495		166-495	190-495	
Post-operative stay	median	4	3	0.25	4	5	**<0.0001**	4	4	0.987
	mean	4.11	3.62		3.69	4.78		4.03	4.05	
	CI 95%	3.80-4.43	2.94-4.29		3.38-4.0	4.22-5.34		3.65-4.42	3.6-4.5	
	Range	2.0-8.0	2.0-.5.0		2.0-7.0	2.0-8.0		2.0-8.0	2.0-8.0	

Abbreviations : IBR : Immediate Breast Reconstruction, DBR : Delayed Breast Reconstruction, BMI : Body Mass Index

Table 3: Results of binary logistic regression analysis.

		OR	CI 95%	p
with implant versus no				
mastectomyweight	<=330gr	1		
	> 330gr	**8.8**	2.65-29.17	**<0.001**
Periods	P1	1		
	P2	**0.156**	0.043-0.567	**0.005**
	P3	**0.051**	0.010-0.249	**<0.0001**
autologous versus no				
Radiotherapy	No	1		
	Yes	0.512	0.149-1.76	0.289
	previous RTH	0.907	0.285-2.89	0.869
	NAC+RTH	**0.065**	0.012-0.346	**0.001**
Reconstruction	IBR	1		
	DBR			1
type of mastectomy	NSM	1		
	SSM	1.849	0.687-4.976	0.223
	standard			1
time of surgery≥305 min				
type of mastectomy	NSM	1		
	SSM	**0.239**	0.078-0.734	**0.012**
	standard	0.162	0.020-1.322	0.089
type of reconstruction	no autologous	1		
	implant/no-autologous	0.684	0.117-4.014	0.674
	autologous	**0.204**	0.046-0.913	**0.038**
	implant/autologous	0.324	0.045-2.347	0.265
Periods	P1	1		
	P2	**0.047**	0.009-0.238	**<0.0001**
	P3	**0.027**	0.004-0.170	**<0.0001**
post-operativestay≥4 days				
Periods	P1	1		
	P2	**0.168**	0.028-1.001	**0.05**
	P3	0.166	0.023-1.210	0.076
type of reconstruction	no autologous	1		
	implant/no-autologous	1.753	0.272-11.29	0.555
	autologous	0.87	0.203-3.730	0.851
	implant/autologous	4.125	0.338-50.37	0.267
indication mastectomy	primitive BC	1		
	local recurrence	2.759	0.761-10.00	0.122
BMI	< 23.5	1		
	≥ 23.5	2.077	0.736-5.863	0.168
duration of surgery	< 305 min			
	≥ 305 min	1.243	0.427-3.619	0.689
age	<= 50 years	1		
	> 50 years	1.569	0.603-4.082	0.356

Abbreviations: BMI: Body Mass Index, OR: Odds Ratio, CI: Confident Interval, NAC: Neo-Adjuvant Chemotherapy, RTH: Radiotherapy, BC: Breast Cancer.

≥305min were: SSM (OR: 0.239), autologous RLDF without implant (OR: 0.204), periods P2 (OR: 0.047) and P3 (OR: 0.027) (Table 3).

5.3. Post-Operative Outcome

Median time of post-operative hospitalization was 4 days (Table 2), greater when reconstruction was performed with implant (Tables 1-2).

In univariate analysis, time of post-operative hospitalization was significantly different according to type of reconstruction (0.033), indication of surgery (primitive or local recurrence or prophylactic) (0.046), type of robot used (<0.0001), duration of surgery (0.055), BMI (0.033), periods (0.003), age (0.031). Others factors were non-significant: type of mastectomy, IBR/DBR, type of incision, axillary surgery, radiotherapy, installation, duration of anesthesia, mastectomy weight, surgeon, cup size.

In binary logistic regression significant factor of time of post-operative hospitalization≥4 days was period P2 (OR: 0.168) (Table 3).

Total complication rate was 44.5% (46 patients): 30 grade 1, 5 grade 2(1 infection, 1 mastectomy bleeding, 1 NAC partial necrosis and 2 limited cutaneous necrosis) and 10 grade 3 (5 infections, 3 hematomas, 1 mastectomy bleeding and 1 dorsal bleeding). Complication rate related to RLDF was 30.7%: 30 grade 1 (dorsal seroma) and 1 grade 3 (re-operation for dorsal bleeding).Three implant losses were observed: 1 SSM for local recurrence, 1 robotic NSM after NAC and radiotherapy, 1 robotic NSM for patient with high BMI (32.2).

In univariate analysis, type of reconstruction with or without implant was significantly associated with grade of complication (p=0.048).

Lipofilling was performedin 8 patients, at the end of follow-up, for 41 patients operated between July 2017 and March 2018 (19.5%), in all cases after autologous RLDFR without implant, with 1 procedure in 5 cases and 2 in 3 cases, with 343cc median cumulative volume of re-injected fat (mean: 437, CI95% 247-626, range: 200- 810).

6. Discussion

We reported the largest series of RLDFR without dorsal scar, performed with a single incision in axillar basin for NSM and in central breast for SSM with NACx resection. For patients with previous external breast scar for conservative breast resection or for DBR, we used this previous scar. RLDFR was indicated in selected cases according to patient's choice and particularly for patients who don't want reconstruction with breast implant (68.3% without implant in our study).We reported an increased rate of RLDFR without implant during successive periods and an increased rate of autologous RLDFR for patients with mastectomy performed after neo-adjuvant chemotherapy and radiotherapy, according to patient's and surgeon's preferences.

RLDFR could be performed after previous radiotherapy in 40.9% of IBR (36/88) (22 local BC recurrence and 14 mastectomy performed for primary BC after neo-adjuvant chemotherapy and radiotherapy) and in 61.5% of DBR (8/13).

A decreased of time of surgery and anesthesia were observed during successive periods in relation with surgeon learning curve but also in relation with anesthetists and nurses learning curve, particularly for patient's installation. Post-operative hospitalization stay decreased during the second period and was lesser for RLDFR without implant.

We confirmed reproducibility and safeties of RLDFR with a low complication rate: one re-operation have been required for dorsal bleeding. The implant loss rate (9.4%) was higher than others reported cases series of R-NSM but in our study previous radiotherapy was performed in 2 of these 3 patients.

Few experiences with RLDFR were reported [12-15, 16] including no more than 17 procedures. In Selber et al study [12] seven patients were reported with RLDF reconstruction performed through an axillar incision for NSM without use of mono-trocar device. Chung et al. [15] reported 12 RLDF procedures through a 5-6 cm axillar incision without CO2 gas insufflation for 3 DBR, 4 IBR with NSM and 5 cases of chest wall deformity. Clemens et al. [14] reported 17 RLDFR in delayed-immediate breast reconstruction after SSM and placement of a tissue expander through anterior mastectomy incision without mono-trocar device. Lai et al [16] reported 2 cases of R-NSM and IBR with RLDFR. Some differences in robotic surgical technique must be underlined: a single incision realized around NACx for SSM and the use of a mono-trocar device. The endoscopic approach decrease donor-site morbidity [6] but the manual control of a two dimensional in-line endoscopic camera with limited internal mobility produces an inadequate optical window around the curvature of the thorax and the rigid-tip instruments also are inadequate to work along the curvature of the thorax. The use of 3D endoscopic surgery offers a magnified view [3] but without the 7 degrees of freedom of motion at the tips of the robotics instruments. Chung et al [15] reported that gas inflation using CO2 may lead to intraoperative hypothermia, which is linked to a higher rate of postoperative complications [20]: In our experience we used a low

pressure of insufflations (7 mm) and gas inflation had no adverse impact of hypothermia with a systematic use of patient warming blanket.

6.1. Indications of RLDFR

Chung et al reported 3 RLDFR for DBR following tissue expander insertion or breast conserving surgery, with a mastectomy scar on the inferior-lateral border of the breast, 4 IBR for NSM through an incision on the lateral side of the breast and 5 cases of chest wall deformity correction.

As we reported, RLDFR was proposed in most cases after previous radiotherapy. In Clemens et al study [14], 17 RLDFR was performed for SSM with delayed-immediate breast reconstruction after radiotherapy at an average of 7.1 months after the end of radiation. Selber et al [12] reported 7 RLDF dissections with 5 breast reconstructions, 3 for NSM and 2 with expander exchange for implant after radiotherapy. However, any study reported NSM with RLDFR for local recurrence with previous radiotherapy (22 patients with NSM and RLDFR in our study for local breast recurrence). For patients with previous radiotherapy for local recurrence or after neo-adjuvant chemotherapy and radiotherapy[22-24], the latissimus dorsi-muscle nourishes and protects the thin skin. In these cases, RLDFR can be associated with implant according to breast size and to patient's choice. One or several lipofilling were next proposed in order to obtain good cosmetic result and sufficient breast volume. Atrophy of the muscle flap can occurred with the need of future lipofilling for volume replacement.

6.2. Operative Time

Chung et al [15] reported a mean operative time of 400 min and Lai et al reported 2 cases with a total operative time of 440 and 300min in comparison with a mean of 309 min in our study. Clemens et al [14] reported an average time for RLDF dissection of 92 min (range 65-155 min) and robotic set up time averaged 23 minutes in Selber et al study [12]. As we reported, there were no conversions to conventional open surgery in others studies [12, 14-16].

Clemens et al [14] reported a complication rate of 16.7% with 1 re-operation (8.3%) which is comparable with our result with 1 re-operation for RLDF dissection (1%).

RLDFR was proposed in selected cases, 20.7% of IBR during the study period, with an increased rate of IBR particularly for patients with previous radiotherapy (43.6%: 44/101) or for patients with possible indication of PMRT (29.8%: 17/57) according to pathologic results and particularly axillary lymph node status [25].

Chung et al [15] reported a very good satisfaction rate considering satisfaction-general outcomes, satisfaction scar and satisfaction symmetry. Clemens et al reported a comparison between 12 RLDFR and 64 traditional open techniques with comparable morbidity rates. We don't reported satisfaction of patients which required longer follow-up considering necessary time to achieved breast reconstruction particularly for patients who need post-operative adjuvant treatment. We planned a multi-centric prospective trial with quality of life and satisfaction analysis, different times of procedures analysis (time of installation, of LDF dissection, of breast reconstruction) for patients with RLDFR or endoscopic non-robotic LDFR or open minimal incision with LDFR.

7. Conclusion

RLDFR appeared as a reproducible and safe procedure with a single NAC resection incision for SSM, a single axillary incision for NSM and previous incision use for DBR. An increased of autologous RLDFR was observed according to patient's and surgeon's choice, which provides natural reconstruction followed by lipofilling procedures. Among numerous techniques of reconstruction, this recent technique seems contributive in some cases, particularly in cases of previous radiotherapy or with probability of PMRT. For patients with previous radiotherapy for local recurrence or after neo-adjuvant chemotherapy and radiotherapy the latissimus dorsi-muscle nourishes and protects the thin skin. Contribution of RLDFR required further prospective studies to confirm interest in comparison with others minimal reconstructive surgical technics.

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