

**Autologous Fat Grafting in Post-
mastectomy Breast Reconstruction: Core
Reconstruction and Ancillary Procedure**

Essay

*Submitted for Partial Fulfillment of the
Master Degree in General Surgery*

By

Mahmoud Yassein Saad

M.B.B.CH.

Mansoura University

Under supervision of

Prof. Dr. Ashraf El Zoghby El Saeed

Professor of General Surgery

Faculty of Medicine

Ain Shams University

Prof. Dr. Salah Nasser Mohammed

Professor of Plastic Surgery

Faculty of Medicine

Ain Shams University

Faculty of Medicine

Ain Shams University

2017

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

لَسْبَحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**, the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound gratitude to **Prof. Dr. Ashraf El Zoghby El Saeed**, Professor of General Surgery Faculty of Medicine Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

*I am also delighted to express my deepest gratitude and thanks to **Prof. Dr. Salah Nasser Mohammed**, Professor of Plastic Surgery Faculty of Medicine Ain Shams University, for his kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

Mahmoud Yassein Saad

List of Contents

Title	Page No.
List of Tables	5
List of Figures	6
List of Abbreviations	11
Introduction	1
Aim of the Study	5
Review of Literature	
Surgical Anatomy of the Female Breast	6
Aesthetics of the Female Breast	23
Recent Trends in Breast Cancer Surgery	37
Principles of Fat Grafting	50
Breast Core Reconstruction by Fat Grafting Alone	102
Post-Mastectomy Breast Reconstruction by Fat Grafting as an Ancillary Procedure	144
Summary and Conclusion	151
References	153
Arabic Summary	

List of Tables

Table No.	Title	Page No.
Table (1):	Digestion enzyme and fluid volumes.....	118
Table (2):	Volumes for use of SVF-1 device (the number of total nucleated cells has been estimated using the mean cell yield values obtained using GID procedure of 500,000 cells/mL dry adipose)	119

List of Figures

Fig. No.	Title	Page No.
Fig. (1):	The milk lines	6
Fig. (2):	Stages in breast development	7
Fig. (3):	(A) Structure of the breast. (B) Changes in the breast during lactation. (C) Section of the nipple. (D) Cross-section of the nipple (L) open onto the surface; sebaceous glands (S) are deep to the epidermis	8
Fig. (4):	Cooper's ligament	11
Fig. (5):	Blood supply to the breast	13
Fig. (6):	Blood supply to the breast – cross-sectional view	15
Fig. (7):	Lymph vessels of the breast and the axillary lymph nodes	17
Fig. (8):	Muscles of the chest wall	19
Fig. (9):	Position of breast	26
Fig. (10):	Representative three-quarter profile view	30
Fig. (11):	The inframammary ligament originates from the 5th rib and inserts into the deep dermis of the skin.....	32
Fig. (12):	Ideal breast measurements	34
Fig. (13):	Partition of the right breast into quadrants.....	35
Fig. (14):	Planning the lumpectomy incision.....	42
Fig. (15):	Parallelogram mastopexy lumpectomy.....	44
Fig. (16):	Mastopexy closure	44
Fig. (17):	The batwing mastopexy lumpectomy	45
Fig. (18):	Donut mastopexy lumpectomy	46
Fig. (19):	Reduction mastopexy lumpectomy	47
Fig. (20):	Central lumpectomy	48
Fig. (21):	The general lipocyte distribution from the dermis to the muscular fascia.....	54
Fig. (22):	Showing preferable sites for fat harvesting.....	58

List of Figures cont...

Fig. No.	Title	Page No.
Fig. (23):	Sites of incisions placement marked by red circles.....	59
Fig. (24):	Insertion of harvesting canula.....	64
Fig. (25):	Canula tip and lumen of the Luer-Lok syringe	65
Fig. (26):	The inserted cannula is attached to a 10 cc Luer-Lok syringe.....	66
Fig. (27):	Minimizing friction burns by using oil fatty tissue.....	67
Fig. (28):	Multi-holed canula.....	68
Fig. (29):	Complete closed-syringe microcannula system	70
Fig. (30):	15 and 25 cm cannulas	71
Fig. (31):	Separated 3 zones of lipoaspirate.....	73
Fig. (32):	Cannula is removed from the syringe and replaced with a plug.....	74
Fig. (33):	The plug is twisted on to create a seal.....	75
Fig. (34):	The plugs that accompany the syringe should be avoided	75
Fig. (35):	The plunger is removed from the proximal end of the syringe	76
Fig. (36):	The syringe without the plunger is placed into a centrifuge.....	77
Fig. (37):	Placement of syringes is balanced on the opposite side.....	78
Fig. (38):	Lid closure and timmer setting	79
Fig. (39):	The centrifuged syringes are removed carefully.....	79
Fig. (40):	Drainage of the aqueous component	81
Fig. (41):	Wicking the most superior portion of the harvested fat	82
Fig. (42):	Fat will often stick to the neuropad when removed.....	83
Fig. (43):	The plunger is replaced after allowing the fatty tissue to slide down to the edge of the syringe.....	83
Fig. (44):	Care should be taken to keep both syringes in a relatively vertical orientation.....	84

List of Figures cont...

Fig. No.	Title	Page No.
Fig. (45):	The index finger on the Luer- Lok aperture controls the slippage of the fat back to the proximal end of the syringe	85
Fig. (46):	The varying densities of processed lipoaspirates	86
Fig. (47):	A blunt 17-gauge cannula with the proximal end has a hub that will fit into a Luer-Lok syringe	87
Fig. (48):	Instruments for structural fat grafting must be efficient and cause minimal trauma to the grafted tissue during placement.....	88
Fig. (49):	<i>Coleman types</i>	89
Fig. (50):	Sharp instrument separates the tissues in its path creating a space	90
Fig. (51):	The natural tissue planes separate in a more physiologic fashion.....	91
Fig. (52):	No fatty tissue should be ejected during the advancement of the cannula	92
Fig. (53):	The plunger of the 1mm syringe is pressed slightly while the cannula is being withdrawn.....	92
Fig. (54):	The intact parcels of fatty tissue are somewhat separated by the tissues of the recipient site to maximize the surface area of contact between the donor and recipient tissues.....	93
Fig. (55):	The three-dimensional technique of placing refined fat	94
Fig. (56):	Surface irregularities	95
Fig. (57):	Vascularization of the fatty tissues	96
Fig. (58):	Fatty tissue death or calcification.....	96
Fig. (59):	(A) Preoperative. (B) Postoperative following delayed left breast fat grafting after BCT.....	105
Fig. (60):	(a) Preoperative. (b) Postoperative after delayed fat grafting after BCT.....	105

List of Figures cont...

Fig. No.	Title	Page No.
Fig. (61):	The Brava system	106
Fig. (62):	Aspirating processed fat graft from the PureGraft.....	112
Fig. (63):	Fat harvesting: (<i>blue</i>) Vacuum. (<i>Red</i>) Aspiration	115
Fig. (64):	Three washes in the GID canister	116
Fig. (65):	Digital scale balance	117
Fig. (66):	GIDzyme-2 GMP GRADE collagenase enzyme	119
Fig. (67):	Fat after digestion: supply/creamy appearance.....	120
Fig. (68):	Shaking incubator in action for 40 min	120
Fig. (69):	Sixty milliliter syringe with Human Albumin solution to be used to stop buffer	121
Fig. (70):	GID SVF-1 plus centrifuge balance canister inserted in the centrifuge.....	122
Fig. (71):	GID canister after centrifugation	123
Fig. (72):	Cell pellet after centrifugation	123
Fig. (73):	Cell pellet after fluid removal.....	123
Fig. (74):	Total cell pellet SVF volume has to be divided and added to each 60 ml syringe of fat	124
Fig. (75):	Micrometer filter and Eppendorf saline sterile Essay tube for cell counter.....	125
Fig. (76):	Particular of the curved tip of the Tuohy needle.....	129
Fig. (77):	Fat graftings are placed immediately above the major pectoralis fascia up to the subcutaneous space just below the dermis with closed-sky procedure	130
Fig. (78):	Intramuscular breast lipoinjection in opensky procedure	131
Fig. (79):	A 4-cm incision is performed only in the epidermis and in two-thirds of the dermis and the incision continued for 3 mm at both ends	133

List of Figures cont...

Fig. No.	Title	Page No.
Fig. (80):	Permanent nonabsorbable suture of 0 thickness with a large needle is passed, which enters through one of these orifices and exits through the other, covering as much tissue as possible; on tying it firmly, to pucker the tissue and thus give the desired cone shape to the lower quadrants	134
Fig. (81):	The knot is hidden in one of the edges of this incision	135
Fig. (82):	Fat injection into a skin sparing mastectomised breast	136
Fig. (83):	From the point where the nipple areola complex will be placed, an isosceles triangle is drawn facing downwards towards the site of the future inframammary fold, wide enough when the two sides are joined to create the desired cone shape with an inverted "T" scar.	137
Fig. (84):	The pexia and the inframammary fold at the level of the sixth rib are then performed	138

List of Abbreviations

Abb.	Full term
<i>ADSCs</i>	<i>Adipocyte derived stem cells</i>
<i>AFG</i>	<i>Autologous Fat Graft</i>
<i>BCS</i>	<i>Breast-conserving surgery</i>
<i>BCT</i>	<i>Breast conserving therapy</i>
<i>DCIS</i>	<i>Ductal carcinoma in situ</i>
<i>DIEP</i>	<i>Deep inferior epigastric perforator</i>
<i>FCI</i>	<i>Fasciocutaneous infragluteal</i>
<i>GID SVF-1</i>	<i>The Gid Group, Stromal Vascular Fraction</i>
<i>IGAP</i>	<i>Inferior gluteal artery perforator</i>
<i>ISCT</i>	<i>International Society for Cellular Therapy</i>
<i>LA</i>	<i>Local anaesthetic</i>
<i>LDF</i>	<i>Latissimus dorsi flap</i>
<i>LPC</i>	<i>Lower pole convexity</i>
<i>LPL</i>	<i>Lower pole line</i>
<i>LR</i>	<i>Lactated Ringer's solution</i>
<i>M-Ni</i>	<i>Manubrium notch to the center of the nipple</i>
<i>MSCs</i>	<i>Mesenchymal stem cells</i>
<i>NAC</i>	<i>Nipple areola complex</i>
<i>NM</i>	<i>Nipple meridian</i>
<i>N-Ni</i>	<i>d</i>
<i>NSABP</i>	<i>National Surgical Adjuvant Breast and Bowel Project</i>
<i>PAP</i>	<i>Profunda femoral artery perforator</i>
<i>PMRT</i>	<i>Post-mastectomy radiotherapy</i>
<i>RT</i>	<i>Radiotherapy</i>
<i>SGAP</i>	<i>Superior gluteal artery perforator</i>
<i>SSM</i>	<i>Skin Sparing Mastectomy</i>
<i>TMG</i>	<i>Transverse myocutaneous gracilis</i>
<i>TRAM</i>	<i>Transverse rectus abdominis myocutaneous flap</i>
<i>U</i>	<i>Upper pole</i>
<i>UPL</i>	<i>Upper pole line</i>
<i>UPS</i>	<i>Upper pole slope</i>

Abstract

On the contrary there is much evidence in literature concerning the positive effect of lipofilling after I stage and II stage breast reconstruction.

Many studies have documented the protective and therapeutic effect of the injected fat against the dangerous consequence of radiotherapy on tissues. Indeed, if performed during RT, lipotransfer is able to reduce the risk of capsular contracture, tissues ulceration and consequently of implant exposure as it provides a major thickness of the tissue above the implant. This is basically due to adipocytes and pre-adipocyte's role in tissue trophism and healing process.

More commonly lipofilling is used to uniform and fill some irregularities and/or scars of the reconstructed breast after the insertion of the definitive prosthesis to ameliorate the definitive shape of the reconstructed breast or to fill the nipple.

Keywords: *International Society for Cellular Therapy- Latissimus dorsi flap - Lactated Ringer's solution - Mesenchymal stem cells- Nipple areola complex - Nipple meridian*

INTRODUCTION

Breast reconstruction is a fascinating and complex field which combines reconstructive and aesthetic principles to provide the best results. The goal of breast reconstruction is to restore the breast shape and to improve a woman's psychological status after cancer treatment. Successful breast reconstruction requires understanding of the different reconstructive techniques and a thorough knowledge of breast aesthetics (*Del Vecchio and Fichadia, 2012*).

The history of breast reconstruction has followed the history of breast cancer surgery. As the various techniques for cancer excision evolved over the past century, the reconstructive techniques had to likewise evolve (*Del Vecchio and Fichadia, 2012*).

Halsted introduced the radical mastectomy and at the same time discouraged initial attempts at breast reconstruction because he believed it could hide local recurrence. **Ombredanne** is credited with using the pectoralis minor muscle flap to create a breast mound, whereas **Tansini** is the first to use the latissimus dorsi myocutaneous flap for breast reconstruction (*Losken and Jurkiewicz, 2002*).

The use of prosthetic materials like polyvinyl sponges in the pre-antibiotic era, had many complications. The introduction of silicone gel-filled breast implants started a new

era in breast reconstruction following World War II, and these was widely accepted after introduction of tissue expansion as a first step. It has many benefits, but needs long term follow up and associated with some complications (*Radovan, 1982*).

At the early seventies, with a better understanding of the vascular supply to the skin, microvascular techniques were introduced and this resulted in re-introduction of the latissimus dorsi muscle flap for breast reconstruction which became a cornerstone flap for a short period of time as it had many disadvantages like inadequate bulk of the muscle, often necessitating an underlying implant to fully reconstruct the breast volume. In addition, the donor site scar left on the back was significant (*Del Vecchio and Fichadia, 2012*).

In 1982, Carl Hartrampf introduced the transverse rectus abdominis myocutaneous flap “TRAM” flap which became one of the most popular methods of autologous breast reconstruction today but not without drawbacks. A major disadvantage of this flap is the sacrifice of the rectus muscle, which often results in significant donor site morbidity (*Hartrampf et al., 1982*).

With further improvements of the microsurgical techniques, perforator flaps became popular in the 1990s with development of multiple flaps which depend on the skin and subcutaneous tissue to reconstruct the breast and keep the muscles in place to preserve its function. But this technique needs extensive experience in microvascular techniques and is