Atlas of Cosmetic breast surgery

Paolo PERSICHETTI

EDIZIONI MINERVA MEDICA
Why publishing a new atlas of breast cosmetic surgery? Several are the answers that can be given to this question. To share the authors’ different approaches to the patients’ requests; to find alternative solutions to issues that do not strictly fall into the discussed subjects, but that belong, as it often happens, to different diagnostic classes; and lastly, to seek the theoretical assumptions and clinical applications behind each author’s experience.

When consulting this atlas, everyone will have the chance to find the expression of the founding Schools and Cultures that, albeit of different origins and philosophical beliefs, still preserve the medical act of Cosmetic Surgery as element adhering to the ethical principles of evidence-based medicine.

PAOLO PERSICHETTI
Plastic and Reconstructive Surgery Department,
Campus Bio-Medico di Roma, University of Rome,
School of Medicine, Rome, Italy
Ziyad Alharbi  
Department of Plastic Surgery, Hand Surgery, Burn Center, RWTH Aachen University Hospital, Aachen, Germany

Eric Auclair  
Private practice, Clinique Nescens Paris Spontini, Paris, France

Achille Aveta  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

Priscilla Balbinot  
Member of the Brazilian Society of Plastic Surgery, Curitiba-PR, Brazil

Valeria Bandi  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Barbara Banzatti  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Mauro Barone  
Plastic and Reconstructive Surgery Unit, Campus Bio-Medico University, Rome, Italy

Franco Bassetto  
Clinic of Plastic and Reconstructive Surgery, University of Padua, Italy

Beniamino Brunetti  
Unit of Plastic Surgery and Dermatology, Department of Medicine, Campus Bio-Medico, University of Rome, Italy

Stefano Bruschi  
Department of Reconstructive and Aesthetic Plastic Surgery, Città della Salute e della Scienza Hospital, University of Turin, Italy

Alessio Caggiati  
Plastic Surgery Department, Istituto Dermopatico dell’Immacolata I.D.I. IRCCS, Rome, Italy

Barbara Cagli  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

Gabriella Cassotta  
Unit of Plastic Surgery and Dermatology, Department of Medicine, Campus Bio-Medico, University of Rome, Italy

Manuel Francisco Castello  
Division of Plastic Reconstructive and Aesthetic Surgery, Clinica Villa Salaria, Rome, Italy

Barbara Catania  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Fabio Caviggioli  
Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Unit of Plastic Surgery, MultiMedica Holding Spa, Sesto San Giovanni (MI), Italy

Valerio Cervelli  
Department of Plastic and Reconstructive Surgery, University of Tor Vergata, Rome, Italy
Maria Cecília Closs Ono  
Department of Plastic Surgery, Federal University of Paraná (UFPR), Curitiba-PR, Brazil; Member of the Brazilian Society of Plastic Surgery

Annalisa Cogliandro  
Plastic and Reconstructive Surgery Unit, Campus Bio-Medico University, Rome, Italy

Michele R. Colonna  
Plastic Reconstructive and Aesthetic Surgery Unit, University of Messina, Policlinico “G. Martina”, Messina, Italy

Adriana Cordova  
Plastic and Reconstructive Surgery Unit, Department of Surgical, Oncological and Oral Sciences, University of Palermo, Italy

Guido Cornegliani  
Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Unit of Plastic Surgery, MultiMedica Holding Spa, Sesto San Giovanni (MI), Italy

Francesco D’Andrea  
Plastic and Reconstructive Surgery Department, Second University of Naples, Italy

Fabrizio De Biasio  
Breast Unit, Department of Plastic and Reconstructive Surgery, University of Udine; “S. Maria della Misericordia” Hospital, Udine, Italy

Liliana De Santo  
Division of General Surgery (Breast Surgery), “Fatebenefratelli” Hospital, Isola Tiberina, Rome, Italy

Gabriele Delia  
Plastic Reconstructive and Aesthetic Surgery Unit, University of Messina, Policlinico “G. Martina”, Messina, Italy

Giovanni di Benedetto  
Department of Plastic and Reconstructive Surgery, Marche Polytechnic University Medical School, University Hospital of Ancona, Italy

Giuseppe Di Taranto  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Sapienza” University of Rome, Policlinico Umberto I, Rome, Italy

Davide Forcellini  
Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Unit of Plastic Surgery, MultiMedica Holding Spa, Sesto San Giovanni (MI), Italy

Daniela Francescato Veiga  
Plastic Surgery Division, Federal University of Sao Paulo - Escola Paulista de Medicina (UNIFESP - EPM) and University of Vale do Sapucai (UNIVAS), Sao Paulo, Brazil

Claudia Frigo  
Institute of Aesthetic and Plastic Surgery Dr. Sera-Renom, Hospital Quirón Barcelona, Universitat Internacional de Catalunya, Spain

Pietro Gentile  
Department of Plastic and Reconstructive Surgery, University of Tor Vergata, Rome, Italy; Plastic and Reconstructive Surgery, Catholic University, Tirane, Albania

Micol Giaccone  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Silvia Giannasi  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy
Gabriele Giunta
Plastic and Reconstructive Surgery Unit, Department of Surgical, Oncological and Oral Sciences, University of Palermo, Italy

Ruth Graf
Department of Plastic Surgery, Federal University of Paraná (UFPR), Curitiba-PR Brasil; Member of the Brazilian Society of Plastic Surgery (SBCP) and International Society of Plastic Surgery (ISAPS), American Society for Aesthetic Plastic Surgery (ASAPS)

Luca Grasetti
Department of Plastic and Reconstructive Surgery, Marche Polytechnic University Medical School, University Hospital of Ancona, Italy

Elizabeth J. Hall-Findlay
Banff Plastic Surgery, Alberta, Canada

Riccardo Iannuzzi
Division of Plastic and Reconstructive Surgery, Campus Bio-Medica, University of Rome, Italy

Marco Klinger
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Francesco Klinger
Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Unit of Plastic Surgery, MultiMedica Holding Spa, Sesto San Giovanni (MI), Italy

Luca Lancerotto
Clinic of Plastic and Reconstructive Surgery, University of Padua, Italy

Rosaria Laporta
Plastic Surgery Department, Sant’Andrea Hospital, School of Medicine and Psychology, “Sapienza” University of Rome, Italy

Davide Lazzeri
Division of Plastic Reconstructive and Aesthetic Surgery, Clinica Villa Salaria, Rome, Italy

Andrea Lisa
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Flavia Lupo
Plastic Reconstructive and Aesthetic Surgery Unit, University of Messina, Policlinico “G. Martino”, Messina, Italy

Carlo Magliocca
Division of General Surgery (Breast Surgery), “Fatebenefratelli” Hospital, Isola Tiberina, Rome, Italy

Luca Maione
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy

Giovanni Francesco Marangi
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

Alexandre Marchac
Private practice and Consultant Plastic Surgeon at Hopital Européen Georges Pompidou, Paris, France

Lydia Masako Ferreira
Plastic Surgery Division, Federal University of Sao Paulo - Escola Paulista de Medicina (UNIFESP - EPM); Director of Medicine III CAPES; Researcher CNPq 1A; Director of Scientific Department of Brazilian Plastic Surgery Society (SBCP), Sao Paulo, Brazil
AUTHORS

Paolo G. Morselli  
Bologna University - Alma Mater Studiorum Plastic, Reconstructive and Aesthetic Surgery School, Bologna, Italy

Dennis P. Orgill  
Tissue Engineering and Wound Healing Laboratory, Division of Plastic Surgery, Brigham and Women’s Hospital and Harvard Medical School, Boston, MA, USA

Tiziano Pallara  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

Norbert Pallua  
Department of Plastic Surgery, Hand Surgery, Burn Center, RWTH Aachen University Hospital, Aachen, Germany

Pier Camillo Parodi  
Breast Unit, Department of Plastic and Reconstructive Surgery, University of Udine; “S. Maria della Misericordia” Hospital, Udine, Italy

Paolo Persichetti  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

Valentina Pinto  
Bologna University - Alma Mater Studiorum Plastic, Reconstructive and Aesthetic Surgery School, Bologna, Italy

Erind Ruka  
Department of Reconstructive and Aesthetic Plastic Surgery, Città della Salute e della Scienza Hospital, University of Turin, Italy

Marzia Salgarello  
Department of Plastic and Reconstructive Surgery, Università Cattolica del “Sacra Cuore”, University Hospital “A. Gemelli”, Rome, Italy

Marco Salomone  
Department of Reconstructive and Aesthetic Plastic Surgery, Città della Salute e della Scienza Hospital, University of Turin, Italy

Fabio Santanelli di Pompeo  
Plastic Surgery Department, Sant’Andrea Hospital, School of Medicine and Psychology, “Sapienza” University of Rome, Italy

Carlotta Scarpa  
Clinic of Plastic and Reconstructive Surgery, University of Padua, Italy

Nicolò Scuderi  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Sapienza” University of Rome, Policlinico Umberto I, Rome, Italy

Francesco Segreto  
Department of Plastic, Reconstructive and Aesthetic Surgery, “Campus Bio-Medico di Roma” University, Rome, Italy

José Maria Serra-Mestre  
Plastic and Reconstructive Surgery Department, Second University of Naples, Italy

José Maria Serra-Renom  
Institute of Aesthetic and Plastic Surgery Dr. Serra-Renom, Hospital Quirón Barcelona, Universitat Internacional de Catalunya, Spain

Matteo Signoretti  
Division of Plastic and Reconstructive Surgery, Campus Bio-Medico, University of Rome, Italy

Mattia Siliprandi  
Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy
Pierfranco Simone  
*Division of Plastic and Reconstructive Surgery, Campus Bio-Medico, University of Rome, Italy*

Luca Spaziante  
*Department of Reconstructive and Aesthetic Plastic Surgery, Città della Salute e della Scienza Hospital, University of Turin, Italy*

Francesco Stagno d’Alcontres  
*Plastic Reconstructive and Aesthetic Surgery Unit, University of Messina, Policlinico “G. Martina”, Messina, Italy*

Mauro Tarallo  
*Department of Plastic, Reconstructive and Aesthetic Surgery, “Sapienza” University of Rome, Policlinico Umberto I, Rome, Italy*

Stefania Tenna  
*Unit of Plastic Surgery and Dermatology, Campus Bio Medico University of Rome, Italy*

Maria Cristina Toffanin  
*Clinic of Plastic and Reconstructive Surgery, University of Padua, Italy*

Patrick Tonnard  
*Coupure Centre for Plastic Surgery, Ghent, Belgium; Department of Plastic Surgery, Free University of Brussels (VUB), Belgium*

Matteo Torresetti  
*Department of Plastic and Reconstructive Surgery, Marche Polytechnic University Medical School, University Hospital of Ancona, Italy*

Massimiliano Tripoli  
*Plastic and Reconstructive Surgery Unit, Department of Surgical, Oncological and Oral Sciences, University of Palermo, Italy*

Alessandra Veronesi  
*Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy*

Alexis Verpaele  
*Coupure Centre for Plastic Surgery, Ghent, Belgium; Department of Plastic Surgery, Free University of Brussels (VUB), Belgium*

Valeriano Vinci  
*Department of Medical Biotechnology and Translational Medicine BIOMETRA, Reconstructive and Aesthetic Plastic Surgery School, University of Milan; Plastic Surgery Unit, Humanitas Clinical and Research Center, Rozzano (MI), Italy*

Vincenzo Vindigni  
*Clinic of Plastic and Reconstructive Surgery, University of Padua, Italy*

Giuseppe Visconti  
*Department of Plastic and Reconstructive Surgery, Università Cattolica del “Sacro Cuore”, University Hospital “A. Gemelli”, Rome, Italy*

Michele L. Zocchi  
*University of Science VNU-HCM, Ho Chi Min City, Vietnam; Private Practice, Turin, Italy*
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Applied Anatomy of the Breast Using Cadavers</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>History of Breast Implants</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>The Capsule Around the Implants</td>
<td>19</td>
</tr>
<tr>
<td>4</td>
<td>Breast Surgery Planning in Three Dimensions: Footprint, Shape, and Nipple Position</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>Aesthetic Perception of Breasts Before and After Cosmetic Surgery</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>Transaxillary Endoscopic Breast Augmentation</td>
<td>58</td>
</tr>
<tr>
<td>7</td>
<td>Transaxillary Breast Augmentation</td>
<td>62</td>
</tr>
<tr>
<td>8</td>
<td>Composite Breast Augmentation/Lipoimplant</td>
<td>72</td>
</tr>
<tr>
<td>9</td>
<td>Superior Emiperiareolar Augmentation Mastopexy</td>
<td>79</td>
</tr>
<tr>
<td>10</td>
<td>Secondary Circumareolar Augmentation Mastopexy</td>
<td>85</td>
</tr>
<tr>
<td>11</td>
<td>Primary Mastopexy Plus Implants</td>
<td>94</td>
</tr>
</tbody>
</table>

P. Persichetti, A. Aveta, F. Segreto

N. Scuderi, M. Tarallo, G. Di Taranto

P. Persichetti, G.F. Marangi, F. Segreto

E.J. Hall-Findlay

P. Persichetti, A. Cogliandro, M. Barone


P.G. Morselli, V. Pinto

E. Auclair, A. Marchac

S. Bruschi, E. Ruca, L. Spazianate, M. Salomone


F. Stagno D’Alcontres, M.R. Colonna, G. Delia, F. Lupo
12. PERSONAL TECHNIQUE: DUAL-PLANE TREATMENT FOR PTOTIC BREASTS USING ANATOMICAL BREAST IMPLANT
C. MAGLIOCCA, L. DE SANTO

13. REVISIONAL BREAST SURGERY
M.F. CASTELLO, D. LAZZERI, M. TORRESETTI, L. GRASSETTI, G. DI BENEDETTO

14. EXPERIENCE WITH THE NEW GENERATION MICRO POLYURETHANE COVERED SILICONE BREAST IMPLANTS
A. VERPAELE, P. TONNARD

15. PRINCIPLES AND METHODS OF EXTERNAL VACUUM DEVICE IN ENHANCING FAT TRANSFER UPTAKE
F. BASSETTO, V. VINDIGNI, L. LANCEROTTO, M.C. TOFFANIN, C. SCARPA, D.P. ORGILL

16. LARGE VOLUME BREAST FAT TRANSFER: TECHNICAL EVOLUTION AND SAFETY ASPECTS
Based on over 800 cases and 26 years of follow-up
M.L. ZOCCHI

17. AUTOLOGOUS BREAST AUGMENTATION
N. PALLUA, Z. ALHARBI

18. LIPOFILLING FOR BREAST AUGMENTATION
V. CERVELLI, P. GENTILE

19. MASTOPEXY WITHOUT IMPLANTS
L. MASAKO FERREIRA, D. FRANCESCATO VEIGA

20. VERTICAL PATTERN REDUCTION MAMMAPLASTY
P.C. PARODI, F. DE BIASIO

21. INVERTED “T” MASTOPEXY
A. CAGGIATI, S. TENNA

22. J-SCAR REDUCTION MAMMAPLASTY
M. SALGARELLO, G. VISCONTI

23. INVERTED-T REDUCTION MAMMAPLASTY
F. SANTANELLI DI POMPEO, R. IAPORTA

24. SECONDARY AUGMENTATION MASTOPEXY
M. SALGARELLO, G. VISCONTI
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.</td>
<td>BREAST RESHAPING AFTER MASSIVE WEIGHT LOSS</td>
<td>203</td>
</tr>
<tr>
<td></td>
<td>P. PERSICHETTI, B. BRUNETTI, G. CASSOTTA</td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>BREAST RECONTOURING IN POST-BARIATRIC PATIENTS: INVERTED-T SCAR MASTOPEXY WITH AUTOPROSTHESIS OR IMPLANT</td>
<td>211</td>
</tr>
<tr>
<td></td>
<td>P. PERSICHETTI, P. SIMONE, R. IANNUZZI, M. SIGNORETTI</td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>AUTOPROSTHESIS AND MUSCULAR LOOPS IN MASTOPEXY</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>R. GRAF, M.C. CLOSS ONO, P. BALBINOT</td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>SENSITIVITY OF THE NIPPLE AREOLAR COMPLEX AFTER MAMMAPLASTY</td>
<td>229</td>
</tr>
<tr>
<td></td>
<td>F. SANTANELLI DI POMPEO, R. LAPORTA</td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>GYNECOMASTIA</td>
<td>233</td>
</tr>
<tr>
<td></td>
<td>A. CORDOVA, G. GIUNTA, M. TRIPOLI</td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>TUBEROUS BREAST AND ASYMMETRIC BREAST</td>
<td>243</td>
</tr>
<tr>
<td></td>
<td>P. PERSICHETTI, S. TENNA</td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>AESTHETIC IMPAIRMENTS OF THE MALE BREAST</td>
<td>249</td>
</tr>
<tr>
<td></td>
<td>P. PERSICHETTI, B. CAGLI, T. PALLARA</td>
<td></td>
</tr>
</tbody>
</table>
Breast augmentation is among the most commonly performed procedures in plastic surgery, with more than 280,000 cases in the USA in 2014 alone. A thorough knowledge of anatomy is paramount to achieve aesthetically pleasant results and avoid complications. This chapter is meant to be an atlas to assist the surgeon in safely performing breast surgery. General considerations will be given first, with particular focus on the nipple-areola complex. Subsequently, local anatomy will be shown and discussed focusing on breast augmentation.

**GENERAL PRINCIPLES**

**The breast**

The breast extends vertically from the 2nd to the 7th rib and, horizontally, from the parasternal line to the middle axillary line (Figure 1.1). It lies on the pectoralis major, serratus anterior and, inferiorly, external obliquis and rectus abdominis muscles (Table 1-I).

**The fascial network**

The fascial supporting network has been matter of excellent studies. Basically, the breast bud develops within Scarpa’s fascia, which splits into an anterior (superficial fascia) and posterior lamella (deep fascia), surrounding the glandular tissue. The anterior lamella is well defined at the level of the 4th rib. Inferiorly, it loses continuity due to direct dermal insertions of Cooper’s ligaments.

The Cooper’s ligaments run transversally throughout the parenchyma, joining the two lamellae above the 4th rib and anchoring the gland to the pectoralis major muscle fascia. At the 5th rib, in the septum between the rectus abdominis and pectoralis major muscles, these ligaments fan out from the periosteum and inserts to the dermis of the inferior pole and inframammary fold, creating a deep apex triangular fascial condensation, as outlined by by Matousek et al. Radial fibers runs perpendicular to the triangular condensations along the length of the inframammary fold.

The inframammary fold is a key element in breast surgery. From an anatomical standpoint, it is given by the splitting of Scarpa’s fascia and by the insertions of the fibers from the above cited fascial condensations. It lies on the 6th or 7th rib, depending on the degree of ptosis. It is important to notice that, in this area, the fat tissue is divided into two layers by Scarpa’s fascia. In the deeper one, longer horizontal ligaments connect the deep fascia of the rectus abdominis muscle to Scarpa’s fascia, while, in the superficial one, shorter ligaments run from Scarpa’s fascia to the dermis. Thus, the superficial fatty layer results to be thicker, denser and more compact than the deeper one. This peculiarity is paramount when the inframammary fold is surgically violated, such as with inframammary augmentation: if Scarpa’s fascia is incised, the thinner, areolar deeper layer may exert minor resistance to the implant weight, thus resulting in lowering of the inframammary fold or the implant itself.

Medially, the adherence zone between skin and sternum is given by multiple dense transverse connections between periosteum and dermis, fusing the superficial and deep fascia in this region.

Superiorly, above the anterior fascia, the superfi-
clavicular ligaments run, respectively, from the periosteum of the superior and deep inferior aspects of the clavicle to the dermis, creating a superior bony anchor point. A further anchor point is given by the lateral pectoralis major ligament, a fascial thickening between the pectoral fascia and superolateral breast at the lateral aspect of the pectoralis major muscle. The confluence of the fasciae of pectoralis major, pectoralis minor, and serratus anterior muscles creates the continuous lateral curve of the inframammary fold and anchor the breast directly to the fourth, fifth, and sixth ribs. Inferiorly, the pectoralis minor suspensory ligament, which is in continuity with the clavipectoral fascia, directly inserts into the breast parenchyma.

Vascularization and innervation

The arterial blood supply to the breast comes from several different sources, namely the internal mammary artery, the lateral thoracic artery, the superior thoracic artery, branches from the thoracoacromial axis as well as anterior and posterior branches from the 3rd to 6th intercostal arteries. Nevertheless, the dominant supply is from the internal mammary artery, which provides about 60% of the blood through intercostal perforators mainly from the 1st to the 4th spaces. Around 30% of the supply is from the lateral thoracic artery and its branches. The venous drainage mainly follows the arterial branches. The superficial venous system is often well developed and visible; it anastomoses with the deeper veins. The lymphatic drainage mainly ends to the axillary and internal mammary nodes. The innervation of the breast is also diffuse and variable: several branches from the lateral and anterior 2nd to 6th intercostal nerves, as well as the supraclavicular nerves, are involved.

The nipple areola complex

The areola is located centrally, at the apex of the breast. The nipple is located at the level of the 4th intercostal space.

Vascularization and innervation

As well as the breast, the nipple areola complex (NAC) receives blood supply from several sources. In most cases, it is reached supero-medially, subcutaneously, by branches from perforators of the internal mammary artery, mostly originating from the 2nd and 4th intercostal spaces at the lateral sternal border. At the level of the superolateral breast edge, several branches from the lateral thoracic artery deeply ascend to the NAC, entering it at the superolateral border. These vessels form a rich anastomotic network with those from the internal mammary artery. The branches

---

**Table 1-I – Muscles underlying the breast.**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origins</th>
<th>Insertion</th>
<th>Vascularization</th>
<th>Vascular pattern</th>
<th>Innervation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectoralis major</td>
<td>- Anterior surface of the medial half of the clavicle &lt;br&gt;- Lateral half of the anterior surface of the manubrium and sternum until the joint with the 6th or 7th rib &lt;br&gt;- Costal cartilages from the 2nd to the 6th rib &lt;br&gt;- Aponeurosis of the external oblique muscle</td>
<td>Crest of the greater tubercle of the humerus</td>
<td>Thoracoacromial vessels &lt;br&gt;Lateral thoracic vessels</td>
<td>Type V</td>
<td>Lateral and medial pectoral nerves (C7-8, T1)</td>
</tr>
<tr>
<td>Pectoralis minor</td>
<td>- 3rd to 5th ribs, near the costochondral junction</td>
<td>Coronoid process of the scapula</td>
<td>Thoracoacromial vessels &lt;br&gt;Lateral thoracic vessels &lt;br&gt;Incostant branch from the axillary artery</td>
<td>Type III</td>
<td>Lateral and medial pectoral nerves (C7-8, T1)</td>
</tr>
<tr>
<td>Serratus anterior</td>
<td>- Outer surface of the upper 8 or 9 ribs</td>
<td>Ventral surface of the medial border of the scapula</td>
<td>Lateral thoracic artery &lt;br&gt;Thoracodorsal artery</td>
<td>Type III</td>
<td>Long thoracic nerve (C5-7)</td>
</tr>
</tbody>
</table>
from perforators deriving from the anterior intercostal artery, found laterally at the 4th and 5th intercostal spaces, also contribute to NAC vascularization. Further, less constant, blood supply derive from the lateral thoracic artery, the superior thoracic artery and the thoracoacromial artery. The venous drainage parallels the arterial inflow and also relies on the superficial system.

The 2nd to the 6th intercostal (IC) nerves were reported to supply the NAC. Among these, the lateral cutaneous branch (LCB) of the 4th IC nerve is the most important, due to its size and constancy. Schlenz et al. found this nerve piercing the deep fascia on the midaxillary line and then reaching the nipple deeply within the pectoral fascia in 93% of cases or superficially in the subcutaneous tissue in 7% of cases. In the former course, on reaching the midclavicular line, the nerve turns 90 degrees and reaches the posterior surface of the nipple with tiny glandular branches. In the latter case, the nervous branches reach the nipple laterally, subcutaneously, dividing into multiple fasciculi. The lowermost ones were found to constantly pierce the areola at 5 o’clock and 7 o’clock on the left and right side, respectively. Medially, the NAC receives innervation from the anterior cutaneous branches of the 3rd to 5th intercostal nerves. These branches run into the subcutaneous tissue and reach the areolar edge between 8 and 11 o’clock and 1 and 4 o’clock in the left and right breast, respectively.

**FRESH CADAVER DISSECTIONS**

An incision is made on the mid-sternal line and approximately 3 cm below the inframmary fold (Figure 1.3). The red and blue dots mark the expected location of constant intercostal perforators and of a perforating vein, respectively. Dissection proceeds in supero-medial direction.

 Inferiorly, anterior intercostal perforators are shown (Figure 1.4). On average, 2 or 3 musculo-cutaneous perforators can be found for each intercostal space.

 Medially, large perforating vessels are constantly found. Due to their high pressure, these vessels may be a major issue to deal with in cases of accidental sectioning. By knowing their location, the surgeon can realize what is called “prospective hemostasis”, namely preventing bleeding by coagulation, rather than stopping it. These medial perforating branches exit the intercostal spaces to enter the subpectoral plane approximately 1.5 cm lateral to the midline of the sternum. Then, they course anterolaterally and can be found in the submammary space about 0.5 cm more lateral to their subpectoral position. Consequently, they can be found during submammary dissection at approximately 2.2.5 cm from the mid-sternal line (Figure 1.5). A large vein perforating the pectoralis major muscle is usually found at the 2nd intercostal space (limited by blue lines in figure) 1.5-2.5 cm lateral to the midline (Figure 1.6). The pectoralis major muscle is exposed and its sternal and costal insertions are clearly visible (Figure 1.7 A). The muscle is detached from the costal insertions and medially, its pinnate origins are visible (Figure 1.7 B). The pinnate origins of the pectoralis major are whitish tendinous attachments to the ribs, located medially. Their surgical detachment may allow...
further enlargement of the medial pocket to better accommodate the implant. However, before performing this maneuver, the surgeon should carefully verify that he’s not cutting any muscle insertion to the sternum, instead. The pectoralis major fascia is a very thin structure, 0.1-0.2 mm thick (Figure 1.8). Even in cadavers, it is very difficult to harvest this tissue separately from the surrounding structures. The pectoralis major muscle is lifted. Laterally, the lateral intercostal perforators (red loops) and nerves (blue loops) are visible (Figure 1.9). As discussed previously, the lateral cutaneous branch of the 4th intercostal nerve is regarded as the most important in providing breast and nipple-areola complex sensitivity, due to its size and constancy. Consequently, it is imperative to avoid disruption of this and other branches during pocket dissection or hemostasis as well as its possible compression by very large implants. The fat pad deep to the pectoralis major is dissected, allowing exposure of the thoracoacromial pedicle (red loop) and of the medial and lateral pectoral nerves (MPN and LPN, respectively) (Figure 1.10). The thoracoacromial vessels exit the intercostal space and enter the pectoralis major muscle on its underside, together with the LPN. In this specimen, both the LPN and the MPN pass through the pectoralis minor muscle. However, they may exit medially and laterally to this muscle, respectively, with some variability in size and location. The nerves are named from the originating cord of the brachial plexus rather than their anatomic location, thus resulting in a name opposite to their point of emergence.

The MPN innervates the lateral and lower fibers of the pectoralis major muscle, while the LPN provides innervation for the upper and medial portions. The accidental section of the MPN during pocket dissection does not usually associate with any clinically noticeable weakness of the pectoralis major muscle.
POCKETS

Several pockets have been described to accommodate the implant. In this section, an overview of the available techniques is provided from an anatomical standpoint. Detailed discussion about indications, advantages and tradeoffs of each technique is not among the aims of this section and will be addressed in the related chapters.

Total submuscular pocket

In this technique, the implant is located posterior to pectoralis major and serratus anterior muscles. Although it provides extensive coverage for the implant, if performed from an aesthetic incision, may blunt the lateral breast profile and also progressively results in fibrotic degeneration of the serratus anterior. A major drawback of the total submuscular pocket is the potential risk for superior implant malposition. Moreover, the pectoralis major and serratus anterior muscles are physiologically closely attached to the chest wall. As a consequence, large implants cannot be placed in a total submuscular pocket because these muscles cannot be excessively elevated away from the chest wall while still keeping the peripheral attachments intact. Generally, the total submuscular pocket is more suitable for breast heterologous reconstruction, when coverage is the number one priority, rather than in the aesthetically driven, medically unnecessary, breast augmentation.

Subpectoral pockets

Total subpectoral

When the total subpectoral placement is chosen, the implant is placed posterior to the pectoralis major muscle, preserving all muscle insertions across the inframmary fold. The implant is inserted from laterally, elevating the lateral margin of the pectoralis major muscle. Although this technique is commonly referred to as “total subpectoral”, the interolateral third of the pocket is not covered by the muscle, as shown in this lateral view of the left breast (Figure 1.11). As with the total submuscular pocket, there is a potential risk for superior implant malposition. Generally, if the soft tissue thickness inferior to the inframammary fold (as measured by pinching) is more than 0.4 cm, a dual plane type 1 technique should be preferred.

Dual plane

A dual plane pocket locates the implant posterior to the pectoralis major muscle in the upper breast and posterior to only breast parenchyma in the lower breast. It is accomplished by dividing the pectoralis major origins along the inframammary fold, thus allowing the lower muscle border to rotate supero-medially. Specifically, these insertions are sectioned 1 cm above the desired level of the postoperative inframammary fold. Compared to the total subpectoral pocket, implant lowering is less restricted by this technique. In this picture, the right breast is reflected laterally, while the lower and upper blue lines represent the desired level of the inframammary fold and the muscle incision, respectively (Figure 1.12).

Three types of dual plane pockets were described. In type 1, the inferior muscle edge is not separated from the overlying parenchyma (Figure 1.13 A). In most cases, the lower border of the muscle is expected to retract 2-3 cm.
above its previous position. Among the dual plane approaches, type 1 allows adequate treatment in 90% of the breasts. In type 2, after the whole subpectoral pocket has been dissected, the surgeon incrementally disrupts the adherences between the pectoralis major fascia and the overlying parenchyma, approximately up to the lower edge of the areola (Figure 1.13 B). In type 3, the disruption stops at the level of the nipple or the superior border of the areola (Figure 1.13 C). As the adherences between the muscle and the gland are released, the muscle retracts and progressively rotates superomedially due to the pivot point at the sterno-clavicular insertions. Type 2 and 3 allow to adequately address glandular deformities and they are more indicated in cases of ptotic or constricted breasts.

The separation of the muscle from the gland should be performed gradually, only after pocket dissection. It is imperative not to hamper the sternal origins of the pectoralis major muscle (Figure 1.14). Even a slight release may result in excessive superior retraction, thus causing postoperative contraction deformities such as banding and windowshading as well as downward gravity- and pressure-based dislocation the implant. These insertions are generally divided by mistake if confused for the pinnate origins or in the attempt to reduce the intermammary distance.

Pelle Ceravolo et al. suggested full thickness incision of the pectoralis muscle on a vertical line on the nipple projection for 2-5 inches (Figure 1.15). With this technique, the authors claimed to decrease postoperative dynamic deformity and facilitate stretch of the breast tissue. In this picture, the left breast has been reflected inferiorly and pectoralis major incised before implant placement.

Subfascial pocket

The implant is placed between the pectoralis major muscle and its fascia. The technique was designed to overcome the potential drawbacks of the partial subpectoral pocket, such as breast animation, while still improving the upper
and medial pole contours. The fascia is claimed to provide a tethering force around the breast implant, thus softening the implant contours and reducing its visibility. This approach is technically demanding. Moreover, the pectoralis fascia is very thin (Figure 1.16) and whether it provides any clinical advantage compared to the subglandular approach is still matter of debate.

Subglandular pocket

The implant is placed posterior to the breast parenchyma, anterior to the pectoralis major fascia (Figure 1.17). Dissection is easily accomplished in this plane. It contains more perforators compared to the subpectoral space, as previously discussed. Postoperative breast animation is reduced compared to submuscular techniques: in most cases, only a slight shape change is visible when the pectoralis major muscle contracts, due to the adherence between the capsule and the muscle. The main drawback of this approach is that, in thin patients with minimal breast parenchyma, implant edge visibility and palpability in the upper portion may be an issue. As a consequence, many surgeons indicates the subglandular approach to patients with upper chest soft tissue thickness of 2 cm or more and to those requiring soft tissue scoring on the underside of the breast, such as in cases of tubular breast deformity.

APPROACHES

Inframammary

The inframammary incision is the most widely used. It provides straightforward dissection with easy hemostasis, implant insertion, positioning and control of the inframammary fold placement. All implants and all pockets can be used with this access. The incision is commonly made at the level of the planned postoperative inframammary fold, 1/3 medial and 2/3 lateral to the breast meridian (Figure 1.18). This approach may be challenging in patients with very small breasts and little to no inframammary fold. In such cases, tissue extensibility is not sufficient to fold over an inframammary incision thus resulting in a visible scar. As a consequence, rather than risking scar visibility, periareolar incision may be a more viable option.

Periareolar

This approach provides excellent access for pocket dissection, hemostasis and implant placement. Nevertheless, whether the surgeon passes through breast tissue or tunnel over it to reach its undersurface, it is associated with more tissue trauma and endogenous bacteria exposure compared to the inframammary approach. The feasibility of the periareolar incision also depends on the areolar diameter, which may sometimes limit the volume and width of the implant to be placed. Generally, it is unadvised in patients whose diameter is less than 3-3.5 cm.
The classical approach is a 3 to 9 o’clock incision (Figure 1.19 A), which hampers the inferior branches of the medial and lateral innervation to the nipple-areola complex (NAC). Contrasting evidences have been reported in literature regarding the effects on NAC sensitivity of the periareolar augmentation compared to the inframammary one. Recently, inferolateral incision (5 to 11 and 1 to 7 o’clock in the right and left breast, respectively) has been proposed to completely spare the medial sensitivity, preserving the vascular anastomoses between the internal mammary and the lateral thoracic artery as well as providing excellent surgical access, parallel to the lateral border of the pectoral major muscle (Figure 1.19 B).

**Axillary**

The axillary incision allows to avoid a scar on breast skin. It is more technically demanding than the previous approaches and requires specific instrumentation. In spite of the common belief that anatomic silicon gel implants cannot be placed through this access, several paper published successful outcomes with this approach. The incision line is located high in the axilla, oriented horizontally, 1-2 cm posterior to the pectoralis major muscle (Figure 1.20 A). Both the submuscular and subglandular planes are accessible (Figure 1.20 B), but subglandular dissection may be more challenging with this access. Axillary incisions were shown not to interfere with eventual sentinel lymph node biopsy. Some surgeons incorporated endoscopic technique into the procedure to overcome the lack of bleeding control and to improve visibility during pocket dissection. A possible drawback is that any revisionary procedure requires an additional incision on the breast.

In this picture, the breast is reflected laterally, the pectoralis major muscle is tractioned superiorly and the pectoralis minor is visible (Figure 1.21). A retractor is inserted in the axillary tunnel. The critical structures to preserve, previously described in this chapter, are surrounded by red and blue loops.

**Transumbilical breast augmentation (TUBA)**

The transumbilical approach is the least used one. An incision is made in the umbilicus and a hollow trocar is bluntly inserted through the subcutaneous tissue, angling upwards toward each breast. It requires the passage of an expander first and an inflatable implant then, through the abdomen up to the breast. Both the subglandular and subpectoral pockets can be developed with this technique. It is technically demanding. The disadvantages and the potential complications are significant and must be seriously taken into account when considering this approach: only saline implants can be used; size, location and symmetry of the pocket cannot be well controlled; it allows neither accurate hemostasis nor control of the inframammary fold location; abdominal soft tissue distortion, such as grooving in the upper abdomen, can result from tunneling. As with the axillary approach, any revisionary procedure requires additional incision on the breast.

**REFERENCES**