BrImplant-Based Breast Reconstruction
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Goals
► Review breast reconstruction options after mastectomy and which are ideal for patients
► Show how implants are used in breast reconstruction, and the evolution of implant-based reconstruction over time
► Discuss possible complications with regards to using implants for breast reconstruction

Breast Cancer Statistics¹
► 1 in 8 women will develop breast cancer in their lifetime
► In 2020, it is estimated that 276,480 new cases of invasive breast cancer will be diagnosed
► 48,530 new cases of non-invasive (in situ)
► Breast cancer is the second leading cause of cancer deaths in women
► Second to lung cancer
► In 2020, 42,170 women will die of breast cancer
► Overall 2.6% chance of dying from breast cancer

Breast Cancer Risk Factors²
► Female
► Older age
► Overweight or obesity
► Personal or family history of breast or ovarian cancer
► Genetic mutations (BRCA1, BRCA2)
► Personal history of breast cancer, DCIS, LCIS
► Long menstrual history (starting at early age or late menopause)
► Never having children or first child after age 30
► Recent use of hormonal therapy or menopausal hormone replacement therapy
► Protective factor: breastfeeding for at least one year

Breast Cancer Treatment
► Ancient Egypt¹
► Edwin Smith papyrus 3000-2500 BC
► Age of Enlightenment 16th Century
► Knowledge of anatomy improves surgical techniques
► Anesthesia not developed until mid 19th century³
► Until then, had to rely on speed and technique
► Nabby Adams, daughter of John and Abigail Adams was tied to a chair and her breast was cut off
► Survived surgery, died of the cancer

¹The Night," Michele di Rodolfo del Ghirlandaio, oil on panel, Galleria Colonna, Rome, Italy (1553-1555)
²Unknown artist, "Peres Maldonado Ex-voto" (18th century, after 1777)
³The Night, "Michele di Rodolfo del Ghirlandaio, oil on panel, Galleria Colonna, Rome, Italy (1553-1555)
Breast Cancer Treatment

Radical Mastectomy

- 1894 William Halsted, MD
- Radical mastectomy
- En bloc resection of breast tissue, pectoralis muscles, lymphatic vessels and axillary lymph nodes
- Disfiguring but curative

Modified Radical Mastectomy

- 1972 John Madden, MD
- Preservation of pectoralis muscles
- Removal of breast tissue
- Removal of axillary lymph nodes
- Similar oncological outcomes but improved cosmetics

Breast Cancer Treatment

- 1985 Lumpectomy with postoperative radiation therapy
- Equivalent 5 year survival compared to mastectomy

Skin Sparing Mastectomy

- 1991 Toth and Lappert
- Removal of breast tissue and nipple areolar complex (NAC)
- Helped to facilitate breast reconstruction
- No difference in local, regional, or systemic recurrence
Breast Cancer Treatment

Nipple Sparing Mastectomy
- Freeman 1962
- Hartmann 1999
- Mayo Clinic experience of prophylactic mastectomies
- 1% development of breast cancer
- No difference between simple or nipple sparing mastectomy
- Many other studies have also shown safety

Nipple Sparing Mastectomy
Ideal candidate
- Small breasts
- No ptosis
- Lower BMI
- Non-smokers
- Cancer <3cm in size
- Located >2cm away from nipple
- No history of radiation

Contraindications
- Nipple involvement
- Inflammatory breast cancer

History of Breast Reconstruction
- Advances in mastectomy techniques have also led to advances in the reconstruction of the breast

History of Breast Reconstruction
- First case
- 1895 Vincent Czerny in Heidelberg
- Reconstructed a mastectomy defect for benign disease with fist sized lipoma from the flank

History of Breast Reconstruction
- 1905 Italian surgeon Tanzini
- Difficulty closing defect from Halsted mastectomy
- First latissimus dorsi musculocutaneous pedicled flap breast reconstruction
- Unpopular due to Halsted's opinion that breast reconstruction violated local control of the disease

History of Breast Reconstruction
- The Father of Plastic Surgery
- Sir Harold Gillies
- Born in New Zealand, trained in England
- WWI ballistics and mustard gas created greater injuries, especially facial
- Pedicled tubed flaps
- Walking tubed flaps
History of Breast Reconstruction

Walking Tubed Flaps
- Creation of a tubed flap of skin
- Detach and reattach to another site
- Allow for new vascularization, then detach and reattach to another site

Gilles attempted his first breast reconstruction in 1942
- Used tubed abdominal flap
- Downside
  - Multiple stages of surgery
  - Minimum of 6 months to complete
  - Scarring
  - Poor healing or flap failure

History of Breast Reconstruction

Implant Based
- Use an implant to create a new breast
- One or two stages

Autologous
- Using a patient’s own tissues to form a new breast
  - Latissimus flap
  - Abdominal tissue

Autologous Reconstruction

Latissimus Flap
- 1977 Reinvention of the flap
- Could reconstruct a smaller breast
- Often inadequate sized
- Could combine with implant
- Reduction of opposite breast
- Improved outcomes with skin sparing mastectomies
Latissimus Flap Reconstruction

- 63 y/o Female
- History of right breast cancer
- Underwent lumpectomy and XRT in March 2016
- Developed recurrence in November 2016

11/28/2016

Latissimus Flap Reconstruction

- Underwent first stage reconstruction
  - Right latissimus dorsi musculocutaneous flap and tissue expander placement
- After completion of tissue expansion

2/27/2017

Latissimus Flap Reconstruction

- Underwent second stage reconstruction
  - Replace expander with silicone implant
  - Left mastopexy for symmetry
- 3 months postoperative

10/23/2017

Autologous Reconstruction

- Latissimus flap
  - Scar from back
  - Can affect ROM of arm
  - Seroma of donor site
  - Prolonged recovery

TRAM Flap

- 1982 Hartrampf, Schiefen, and Black
  - Transverse Rectus Abdominus Myocutaneous Flap (TRAM Flap)
  - Uses lower abdominal skin and fat, attached to rectus abdominus muscle
TRAM Flap
- Higher risk patients
  - Obesity
  - Smoking
  - Diabetes
  - Previous abdominal surgeries
- Complications
  - Flap necrosis
  - Prolonged recovery
  - Hernia

DIEP Flap
- Deep Inferior Epigastric Perforator Flap
- 1994 Dr. Robert Allen
  - Spares the rectus muscle
  - Microsurgical connection of Deep Inferior Epigastric vessels to intramammary vessels

DIEP Flap
- Advantages
  - Avoids the use of implants, uses own tissue
  - Ability to shape the breast
  - Less risk of hernia compared to TRAM flap
- Disadvantages
  - Length of surgery
  - Microvascular complication
  - Prolonged initial recovery

Implant Based Reconstruction
- Immediate Reconstruction
  - Done at the time of the mastectomy
  - More skin to work with
  - Direct to implant or two staged reconstruction
- Delayed Reconstruction
  - Done after they have healed from their mastectomies
  - Frequently inadequate skin, need two staged reconstruction
  - Radiation
Delayed Reconstruction

- 61 y/o Female s/p left mastectomy in March 2016
  - Desire for delayed reconstruction
  - Underwent first stage reconstruction with tissue expander on Jan 25, 2017

1/3/2017

After finishing tissue expansion 3/28/2017

- Underwent second stage surgery in July 2017
  - Replace tissue expander with implant
  - Right breast reduction

3 months postop 10/24/2017

1962: Dow Corning makes the first silicone implant
- Used for both breast augmentation and reconstruction

1963: Cronin and Gerow father implant based reconstruction
- Initially done as delayed reconstruction, direct to implant

1971: First case of immediate breast reconstruction
- Direct to implant
- Remained mainstay of reconstruction for remainder of decade

1982: Radovan introduces tissue expansion into breast reconstruction
- Skin limitations for reconstruction are improved

Implant Based Reconstuction

- Total Submuscular
  - Places device under pectoralis major muscle
  - Lifts serratus anterior muscle laterally
  - Lifts rectus abdominus muscle inferiorly
Total Submuscular Implant

- Advantages
  - Healthy muscle barrier over implant
  - Reduced cost
  - Simplicity

- Disadvantages
  - Tighter pocket
  - Poor shape of inferior pole
  - More painful expansion
  - Animation deformity
    - Distortion of breast when flexing pectoralis muscle

Animation Deformity

Implant Based Reconstruction

- Dual Plane Reconstruction\(^{21}\)
  - Scott Spear, MD 2006
  - Partially under pectoralis major muscle
  - Partially under “medial”
    - Acellular dermal matrix (ADM)
  - Creates inferior and lateral borders of reconstruction

Dual Plane Breast Reconstruction

- Advantages
  - More stability of implant position
  - Better shape to inferior pole
  - More room to place expander or implant
  - Possible to do direct to implant reconstruction
  - Fill expander inserer at time of surgery

- Disadvantages
  - Increased cost using ADM
  - Increased seroma or infection using ADM
  - Animation deformity

Dual Plane Breast Reconstruction

Dual Plane Reconstruction

- 36 y/o female

Dual Plane Reconstruction

- 36 y/o female
- BRCA mutation
- Bilateral prophylactic mastectomy
- Dual plane reconstruction with tissue expanders
After completing tissue expansion

4/12/2017

9/21/2017

Dual Plane Reconstruction

- Second stage surgery
- Replaced tissue expanders with permanent silicone implants
- Raised right nipple
- 3 months postoperative

9/21/2017

Before and After

2/16/2017

Dual Plane Reconstruction

- 59 y/o female, Right breast cancer
- Direct to implant reconstruction
- Dual plane technique

6/25/2019

After direct to implant reconstruction

10/8/2019
Implant Based Reconstruction

- Prepectoral Reconstruction
  - First tried in 1970s
  - Fell out of favor
  - Nahabedian 1997
  - Renewed in popularity
  - Implant is placed on top of pectoralis muscle
  - Pocket is made entirely of ADM
  - Wrap implant or coverage of anterior implant

Prepectoral Breast Reconstruction

- Tissue expander wrapped in ADM

Prepectoral Breast Reconstruction

- Tissue expander under ADM, in prepectoral pocket after nipple sparing mastectomy
Prepectoral Breast Reconstruction¹⁰,¹³

Advantages
- Less pain
- Shorter hospital stay
- Not limited by muscle expansion or position of muscle
- Better "cleavage"
- Higher potential for direct to implant reconstruction
- No animation deformity

Disadvantages
- Expense
- More implant rippling
- Need well-perfused mastectomy skin flaps

Prepectoral Reconstruction

- 59 y/o female, Left breast cancer and BRCA1 mutation
- Bilateral mastectomy and first stage reconstruction with prepectoral tissue expanders and AlloDerm

After completion of tissue expansion

10/8/2017

Postoperative
- Inferior malposition of right breast implant
- Inferior capsulorraphy and reinforcement with AlloDerm
- Fat grafting

6/11/2019

Implant rippling

2/27/2018
Another revision surgery...
- More fat grafting
- 3D nipple tattoo reconstruction

12/12/2019

Before and After 2
Revision Surgeries

6/27/2017

12/12/2019

Prepectoral Reconstruction
- 53 y/o female, BRCA1 mutation
- Bilateral prophylactic mastectomy
- Direct to implant reconstruction with prepectoral silicone implants
- Small B cup preoperatively
- Desired C cup reconstruction

3/3/2020

Before and After

3/3/2020

6/23/2020
How To Decide...

- With so many options, how do you choose?

Reconstruction Algorithm

- Does the patient want reconstruction?
  - About 40% of patients undergoing mastectomy choose to have reconstruction
  - Only about half of patients are referred to plastic surgery to discuss
  - Lack of access to plastic surgeons

- Women's Health and Cancer Rights Act 1998
  - Mandate insurance companies cover reconstruction if they cover mastectomy
  - Covers surgery of opposite breast for symmetry

Reconstruction Algorithm

- Autologous vs Implant
  - 81% are implant based
  - Some limitations by BMI or body habitus for autologous
  - Some limitations of size that can be achieved with either

- Consideration of recovery times, multiple surgeries possible

- 75% Immediate Reconstruction
  - Better aesthetics
  - Lower overall cost
  - Improved patient psychological well-being

Breast Implant Reconstruction

- Factors that can influence the type of reconstruction possible
  - Both preoperative and intraoperative decisions
  - Amount of skin available to use
  - Nipple sparing or skin sparing
  - Increasing in size or decreasing in size
  - Refinements of mastectomy flaps

- Spy Machine
  - Indocyanine green picked up by near-infrared camera
  - Can help intraoperative decision making
Complications in Breast Reconstruction

- Mastectomy Reconstruction Outcome Consortium
  - Prospective cohort 9 academic and 2 private practices with high volume breast reconstruction
  - 2234 patients (1415 implant)
  - 92.9% immediate reconstruction
    - 97.9% for implant
    - 30.9% bilateral
    - 38.3% for implants

- Radiation
  - Before Reconstruction
    - 3.5% implant based
    - 18.5% autologous
  - During or after Reconstruction
    - 27.1% implant based
    - 12.6% autologous

- Bleeding/hematoma
  - 3.5%

- Seroma
  - 2.9%

- Wound dehiscence
  - 1.6%

- Radiation
  - Before Reconstruction
    - 5.3% Implant based
  - During or After Reconstruction
    - 20-50% Autologous

Wound Infection

- 10% Implant based
- 3-8% Autologous
- Treatment with washout vs removal
- Mild vs severe infection
- Response to antibiotics
- Pathogen
- Exposure of implant
- Overall salvage rate 64-65%

Wound Infection

- 10% Implant based
- 3-8% Autologous
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Capsular Contracture

- Hardening of scar layer around implant
- Graded 0-4

- Grade 0: Soft, normal
- Grade 1: Hard but not restricting
- Grade 2: Mild restriction
- Grade 3: Severe restriction
- Grade 4: Painful with gross deformity

Table 1. Salvage and Expulsion Rates for Different Classes of Infected and/or Exposed Breast Prostheses

<table>
<thead>
<tr>
<th>Class of Infection and/or Exposure</th>
<th>Successful Salvage Rate (%)</th>
<th>Salvage Rate without Surgical salvage, Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I: Mild infection</td>
<td>24/28 (85.7)</td>
<td>15-20 (74-24)</td>
</tr>
<tr>
<td>Group II: Severe infection</td>
<td>2/4 (50)</td>
<td>24-25 (20-25)</td>
</tr>
<tr>
<td>Group III: Exposed implant</td>
<td>2/4 (50)</td>
<td>25-26 (90-85)</td>
</tr>
<tr>
<td>Group IV: Exposed infection</td>
<td>2/4 (50)</td>
<td>25-26 (90-85)</td>
</tr>
<tr>
<td>Group V: Exposed implant with severe infection</td>
<td>2/4 (50)</td>
<td>25-26 (90-85)</td>
</tr>
<tr>
<td>Group VI: Exposed implant with moderate infection</td>
<td>2/4 (50)</td>
<td>25-26 (90-85)</td>
</tr>
<tr>
<td>Group VII: Actual infection with severe infection</td>
<td>2/4 (50)</td>
<td>25-26 (90-85)</td>
</tr>
</tbody>
</table>

*Values per case*

- Mastectomy flap necrosis
- 6.6%
- Risks:
  - Smoking
  - History of breast reduction or augmentation
  - Nipple sparing mastectomy
  - Obesity
  - Diabetes
Complications in Breast Reconstruction

- Capsular Contracture
  - 0.8%²
  - Only 1 year follow up
  - Most literature 2-30%²
- Prepectoral Reconstruction
  - Subpectoral 52.2%
  - Prepectoral 16.1%

- Risks
  - Bacterial contamination
  - Hematoma or fluid around implant
  - Radiation
  - Subpectoral 16-21%
  - Prepectoral 16.1%

- Capsular Contracture
  - 0.8%
  - Only 1 year follow up
  - Most literature 2-30%

- Prepectoral Reconstruction
  - 12.4% without use of ADM
  - 2.3% with use of ADM

- Submuscular Reconstruction

- History of prior breast conservation with lumpectomy and radiation therapy
  - Both are associated with higher risks of any complication, major complication, and reconstruction failure

- Complications: hematoma, flap necrosis, infection, dehiscence, capsular contracture, implant malposition, seroma, implant rupture

- Major complication: any complication requiring reoperation or rehospitalization

- Reconstruction failure: reoperation without replacement of implant

- Any complication
  - pMRT 40.1%, PMRT 40.1%, no XRT 22.9%

- Major complication
  - pMRT 34%, PMRT 34%, no XRT 15.6%

- Reconstruction failure
  - pMRT 17%, PMRT 17%, no XRT 4.1%

- No difference in reconstruction satisfaction

Capsular Contracture

- 62 y/o female with left breast cancer
- Attempted lumpectomy
- Bilateral mastectomies
- Tissue expander placement in dual plane fashion

After completion of tissue expansion

4/10/2017

1/10/2017
Capsular Contracture

- Bilateral second stage reconstruction
- Replace tissue expanders with silicone implants
- "Lift" left nipple via previous lumpectomy incision
- Looked good for a while...

9/25/2017

Capsular Contracture

- Developed capsular contracture of right breast
- Required capsulectomy, placement of Alloderm, implant replacement
- Done in January 2018
- Looked good for a while...

11/27/2017

Capsular Contracture

- Developed capsular contracture of OTHER breast...
- Required capsulectomy, placement of Alloderm, implant replacement
- Fat grafting to right breast

4/17/2018

Before and After 2 Revision Surgeries
Complications of Breast Reconstruction

- **Implant malposition**
  - Lateral, inferior, medial (symmastia)
  - 0.5%

**67 y/o female, left breast cancer**

- Bilateral mastectomies
- First stage reconstruction with dual plane submuscular tissue expanders

After completion of tissue expansion

- **Implant Malposition**
  - Bilateral second stage breast reconstruction
  - Replace tissue expanders with silicone implants
  - 3 Months postop
  - It was ok for a while...

1/15/2019

- **Implant Malposition**
  - 11 Months later...
  - Worsening of inferior malposition of implants
  - Nipples ride high on the breast
  - Step-off above the implant
  - Revision surgery February 2020
    - Bilateral inferior capsulorrhaphy
    - Reinforcement with AlloDerm
    - Fat grafting to both breasts
    - Placement of new implants

11/12/2019
Complications of Breast Reconstruction

- **Implant Rupture**[^1][^2]
  - 8.7-24.2% at 10 years
  - Third-generation implants: 98% are intact at 5 years, and 83% at 10 years
  - Newer fifth-generation implants: even more improved cohesive and longevity, but long-term data lacking

- **MRI** best tool for evaluation (90% sensitivity and specificity)
- **FDA** recommends screening silicone implants for rupture 3 years after placement and every 2 years thereafter

- **Thin coverage of implants**
- Worse with prepectoral reconstruction
- Can be improved upon with fat grafting
- Use liposuction to harvest fat, inject it to another area
- Expect about 60% take of the fat
- Less in radiated field

Fat Grafting

- **Advantages**
  - Smooths contour and ripples
  - Liposuction of donor site
  - Permanent transfer of fat cells
  - Adds volume to areas that were removed by the mastectomy and that the implant alone cannot fill
  - Can improve the quality of radiated tissues

- **Disadvantages**
  - Oil cysts, fat necrosis
  - Poor take of fat cells
  - Radiated field
  - Possible contour irregularities of donor or recipient site

[^1]: References
[^2]: References
Fat Grafting

- 30% of breast reconstruction patients undergo fat grafting.
- Often require more than one session.

After 2nd stage surgery, before fat grafting

47 days postop after bilateral fat grafting, right breast 300cc, left breast 170cc.

Fat grafting right breast Before and After

Nipple Reconstruction

- Done after healed from implant reconstruction
- Creation with surgery
  - Flap of skin of breast used to form nipple that projects
  - Tattoo color around nipple
  - Always projected
- Creation with 3D tattooing
  - Flat
- Temporary silicone prosthetic

47 y/o Female
Surgical creation of nipple
Procedure for symmetry

- Insurance also required to cover a surgery of the contralateral breast for symmetry
  - Breast augmentation
  - Breast lift (mastopexy)
  - Breast reduction

57 y/o Female
3D tattoo nipple reconstruction by Lenny Renken

55 y/o female
Right breast implant reconstruction, prosthetic nipple, Left mastopexy

55 y/o female
Right breast implant reconstruction

33 y/o female
Left implant reconstruction
Right breast augmentation

33 y/o female
Left implant reconstruction
Right breast augmentation

63 y/o female
Right reconstruction with implant
Left mastopexy

13 y/o female
Left implant reconstruction
Right breast augmentation
63 y/o female
Right reconstruction with implant
Left mastopexy

61 y/o female
Left breast delayed implant reconstruction
Right breast reduction

61 y/o female
Left breast delayed implant reconstruction
Right breast reduction

Recovery

- 2-6 weeks off work
- Depending on job requirements
- Drains
  - 1-2 each breast
  - 1-4 weeks each
- Postop compression bra
  - 4 weeks postop
- Postop restrictions
  - No heavy lifting, pushing/pulling x 6 weeks
  - More important if implant is under muscle
- Postop physical therapy

Conclusions

- Improvement in mastectomy techniques have led to improvements in reconstruction
- Discussion with plastic surgeon to determine what is the best option for reconstruction for each patient
- Many new techniques and advances over the years
- Shorter recovery
- Improved cosmesis
- Complications can occur, and short and long term considerations of reconstruction need to be understood
- Overall patient satisfaction with reconstruction remains high

References

References


