Breast Reconstruction and Radiation Therapy: Current Controversies

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I have nothing to disclose

Chest Wall Irradiation after Tissue Expander / Implant Reconstruction

An Increasing Phenomenon
Chest Wall Irradiation

- Increasingly common following mastectomy
- Need for postoperative radiation may not be known prior to immediate reconstruction

Indications for Post Mastectomy Radiation

- Tumor size ≥ 5 cm
- ≥ 3 metastatic axillary lymph nodes
- +/- 2 metastatic axillary lymph nodes
- Chest wall involvement

Irradiation and Implants

- 40 patients
- Irradiated before, during or after TE/I reconstruction
- 48% ultimately required a flap

S Spear, PRS March 2000
Irradiation and Implants

- 6 patients irradiated after TE/I reconstruction
- 124 non-irradiated patients
- Significant difference in capsular contracture

E Vandeweyer, PRS July 2000

Irradiation and Implants

- Michigan Breast Reconstruction Outcome Study
- 19 patients irradiated after TE/I reconstruction
- Reconstructive failure rate 37%

E Kreuger, Int. J. Rad Oncology
March 2001

TRAM Flaps and Irradiation

- MD Anderson experience
- 32 immediate TRAM flaps
- Irradiated after reconstruction
- Late complication rate 87%

NV Tran et al, PRS July 2001
Tissue Expansion/Implants (TE/I)

Advantages

- Minimal surgery
- Limited patient morbidity
- No donor site
- Satisfactory aesthetic results
Reconstructive Dilemma
Tissue expander in place and patient needs RTX
- Remove expanders if postoperative radiation required?
- Convert to delayed reconstruction?
- Convert to autologous tissue?

Reconstructive Dilemma
Preop knowledge that there will be postop RT
- Delay TE/I reconstruction if radiation might be required?
- Reconstruct with autogenous tissue and then irradiate flap
- What if patient is not a flap candidate?

Reconstructive Dilemma
Potential Solution
(but controversial…)
- Proceed with immediate TE/I reconstruction
- Coordinate a multidisciplinary reconstructive approach that includes chemotherapy, implant exchange and irradiation
Reconstructive Approach

- Mastectomy and TE placement
- Expansion starting 10-14 days postop
- Expansion during chemotherapy
- Exchange for permanent implant 3-4 weeks after chemotherapy completion
- Radiation 3-4 wks after exchange
Objective

To assess the outcome of all patients who underwent chest wall irradiation following immediate TE/I reconstruction using a standard multidisciplinary approach

Outcomes

• Complications
• Aesthetic results
• Patient satisfaction
Capsular Contracture

Modified Baker Classification

- Class IA - Natural
- Class IB - Soft, but detectable on exam
- Class II - Mildly firm
- Class III - Moderately firm
- Class IV - Severe contracture

Methods

- Patient satisfaction
  - Questionnaire
  - Satisfaction with result
  - Method of reconstruction

Results

- 837 reconstructions in 708 patients
- 81 patients irradiated (10%)
- 68 patients evaluated after one year (75%)
### Complications

#### Early

<table>
<thead>
<tr>
<th></th>
<th>Incidence (n=81)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulitis</td>
<td>11%</td>
</tr>
<tr>
<td>Mastectomy Flap necrosis</td>
<td>3%</td>
</tr>
<tr>
<td>Hematoma</td>
<td>1%</td>
</tr>
</tbody>
</table>

### Reasons for Removal of Implant

<table>
<thead>
<tr>
<th></th>
<th>Radiated (n=81)</th>
<th>Not Radiated (n=542)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>3 (3.7%)</td>
<td>5 (0.9%)</td>
</tr>
<tr>
<td>Implant exposure</td>
<td>2 (2.5%)</td>
<td>1 (0.2%)</td>
</tr>
<tr>
<td>Implant leakage</td>
<td>2 (2.5%)</td>
<td>7 (1.3%)</td>
</tr>
<tr>
<td>Recurrent cancer</td>
<td>1 (1.2%)</td>
<td>0</td>
</tr>
<tr>
<td>Capsular contracture</td>
<td>1 (1.2%)</td>
<td>20 (3.7%)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9 (10.9%)</td>
<td>33 (6.1%)</td>
</tr>
</tbody>
</table>

*p=0.0001 for radiated vs. non-radiated patients, Mann-Whitney U test*

### Implant Removal

<table>
<thead>
<tr>
<th></th>
<th>Radiated (n=81)</th>
<th>Non-Radiated (n=541)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 (11%)</td>
<td>33 (6%)</td>
</tr>
</tbody>
</table>
**Overall Success Rate**

<table>
<thead>
<tr>
<th></th>
<th>Radiated (n=81)</th>
<th>Non-Irradiated (n=541)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90%</td>
<td>98%</td>
</tr>
<tr>
<td></td>
<td>(9 Implants removed 1 replaced)</td>
<td>(33 Implants removed 26 replaced)</td>
</tr>
</tbody>
</table>

*p=0.0001 for radiated vs. non-radiated patients, Mann-Whitney U test*

**Capsular Contracture**

<table>
<thead>
<tr>
<th>Contracture*</th>
<th>Radiated (n=68)</th>
<th>Non-Radiated (n=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (no contracture)</td>
<td>22 (32.3%)</td>
<td>45 (60.0%)</td>
</tr>
<tr>
<td>Grade 2</td>
<td>19 (28.0%)</td>
<td>22 (29.3%)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>23 (33.8%)</td>
<td>7 (9.3%)</td>
</tr>
<tr>
<td>Grade 4</td>
<td>4 (5.8%)</td>
<td>1 (1.3%)</td>
</tr>
</tbody>
</table>

*p=0.006 for radiated vs. non-radiated patients, Mann-Whitney U test*

*Modified Baker Classification Scale*

**Aesthetic Results**

<table>
<thead>
<tr>
<th>Aesthetic Result</th>
<th>Radiated (n=66)</th>
<th>Non-Radiated (n=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good to Excellent</td>
<td>25 (38%)</td>
<td>52 (69%)</td>
</tr>
<tr>
<td>Good</td>
<td>28 (42%)</td>
<td>14 (19%)</td>
</tr>
<tr>
<td>Poor to Fair</td>
<td>13 (20%)</td>
<td>9 (12%)</td>
</tr>
</tbody>
</table>

*p=0.0006 for radiated vs. non-radiated patients, Mann-Whitney U test*
Patient Satisfaction

<table>
<thead>
<tr>
<th></th>
<th>Radiated (n=66)</th>
<th>Non-Radiated (n=75)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied with aesthetic outcome</td>
<td>67 %</td>
<td>88 %</td>
</tr>
<tr>
<td>Would choose same method again</td>
<td>72 %</td>
<td>85 %</td>
</tr>
</tbody>
</table>

p=0.0006 for radiated vs. non-radiated patients, Mann-Whitney U test

Clinical Cases
Results and Complications

Implant Exposure
Radiation Burn

Radiation Burn

Post Radiation Capsular Contracture
Capsular Contracture

Mild

Baker 1-2

Grade Ib
Post-exchange (14 months)

Moderate

Baker 3

Pre-op
Severe

Baker 4

Pre-op

Post-op & Pre-exchange
Pre-op

Post-te & pre-exchange

post-exchange (38 months)
Augmenting the Radiated Breast

Pre-op

post-op (3 months)
Pre-op

Post-implant & augmentation (1 month)

Post-implant & augmentation (14 months)
Bilateral Implant Reconstructions with Unilateral Radiation
(The Perfect Controlled Study?)

<table>
<thead>
<tr>
<th>Capsular Contracture Grade</th>
<th>Irradiated Breast (%)</th>
<th>Non-Irradiated Breast (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class IA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Class IB</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Class II</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Class III</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>Class IV</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Summary of Results

- Over 90% of patients with chest wall irradiation post implant reconstruction underwent successful reconstructions
- Almost 80% of these patients had good-excellent results
- About 70% of patients would undergo the same reconstruction again and were satisfied with the outcome

Conclusions

- Implant reconstruction is a reasonable option even when followed by chest wall irradiation
- Particularly in patients who are not candidates for autogenous reconstruction, TE/I should be considered

Conclusions

- Long term effective on implant reconstruction remains unknown
Introduction

- Data regarding use of combined autogenous tissue/implant reconstruction limited
  - Historically high incidence of complications (MDACC)
  - Recently improved outcomes with 2 stage reconstruction (Spear)
Skin Island Design

- Lap pad makes excellent LD
Skin Island Design

- Oblique orientation for transverse skin island
- Position skin island based upon requirements

Flap Elevation and Transposition

Flap Elevation and Transposition
Flap Inset

- LD sutured to inferior skin flap or IMF
- LD sutured to pec major over expander
- PM elevation avoided if possible

Methods

- Retrospective review
- Women who underwent combined latissimus dorsi / prosthetic breast reconstruction
- 8 year period
Methods

Inclusion Criteria

• IMMEDIATE RECONSTRUCTION
• Mastectomy for breast cancer recurrence following previous lumpectomy and adjuvant radiotherapy
• Minimum 6 mos. follow-up

Results

Baseline Characteristics

53 patients met inclusion criteria

- Two-stage expander/implant reconstruction
  - 47 patients

- Single-stage implant reconstruction
  - 6 patients

Results

Baseline Characteristics

• Median age 50.2 yrs (28 - 72)
• Mean time 5.2 yrs (0.3 – 18.9) from radiation to mastectomy and reconstruction
• Median follow-up 27.3 mos (6 – 74.7)
Results
Baseline Characteristics

- Median Radiation Dose 4680 cGy (4110 – 6080)
- Radiation Boost 91.0% (20/22) patients

Results
Baseline Characteristics

Fifty-nine percent of reconstructions had an overall aesthetic result of very good or excellent; 33.3% had a good result.

Expander Dynamics

<table>
<thead>
<tr>
<th>Expander Dynamics</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expander Size</td>
<td>500 cc</td>
<td>300 – 850</td>
</tr>
<tr>
<td># Expansions</td>
<td>4</td>
<td>2 - 9</td>
</tr>
<tr>
<td>Total Expander Fill Relative to Implant Volume</td>
<td>117 %</td>
<td>74 – 241</td>
</tr>
<tr>
<td>Implant Volume</td>
<td>420 cc</td>
<td>180 – 780</td>
</tr>
</tbody>
</table>

Results
Baseline Characteristics

- **94% completed reconstruction** (49/53):
  - 41 patients SILICONE prosthesis
  - 8 patients SALINE prosthesis

- **75.5% contralateral procedure** (40/53):
  - 23 immediate reconstruction
  - 13 breast reduction
  - 3 breast augmentation
  - 1 mastopexy
### Results

#### Complications

<table>
<thead>
<tr>
<th>MINOR Complications</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>0</td>
</tr>
<tr>
<td>Seroma / Hematoma</td>
<td>0</td>
</tr>
<tr>
<td>Partial Flap Necrosis</td>
<td>1</td>
</tr>
<tr>
<td>Mastectomy Flap Necrosis</td>
<td>6</td>
</tr>
<tr>
<td>Seroma Donor Site</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>10 (18.9%)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MAJOR Complications</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection Necessitating Removal of Prosthesis</td>
<td>2</td>
</tr>
<tr>
<td>Expander Deflation</td>
<td>1</td>
</tr>
<tr>
<td>Expander Exposure</td>
<td>0</td>
</tr>
<tr>
<td>Revisional Procedure for Early Capsular Contracture</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4 (7.5%)</strong></td>
</tr>
</tbody>
</table>

#### Aesthetic Result

<table>
<thead>
<tr>
<th>Aesthetic Result</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good / Excellent</td>
<td>25</td>
<td>59.6%</td>
</tr>
<tr>
<td>Good</td>
<td>14</td>
<td>33.3%</td>
</tr>
<tr>
<td>Fair</td>
<td>3</td>
<td>7.1%</td>
</tr>
</tbody>
</table>
### Results

**Capsular Contracture**

<table>
<thead>
<tr>
<th>Capsular Contracture</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade IA or IB</td>
<td>12</td>
<td>28.6%</td>
</tr>
<tr>
<td>Grade II</td>
<td>19</td>
<td>45.2%</td>
</tr>
<tr>
<td>Grade III</td>
<td>11</td>
<td>26.2%</td>
</tr>
<tr>
<td>Grade IV</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

![Pre-op Image]
Results

Results

Results
Results
Possible Predictors

**PRE-OPERATIVE PREDICTORS**
- Time from Radiation to Reconstruction
- Radiation Dose
- Radiation Boost

**POST-OPERATIVE OUTCOMES**
- Capsular Contracture
- Aesthetic Outcome
### Results

#### Predicting Capsular Contracture

<table>
<thead>
<tr>
<th>Possible Predictors</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Dose (cGy)</td>
<td>0.99</td>
<td>(0.99, 1.00)</td>
<td>0.419</td>
</tr>
<tr>
<td>Radiation Boost (Y/N)</td>
<td>0.30</td>
<td>(0.01, 6.38)</td>
<td>0.440</td>
</tr>
<tr>
<td>Time from Radiation to Reconstruction (yrs)</td>
<td>0.84</td>
<td>(0.70, 0.98)</td>
<td>0.360</td>
</tr>
<tr>
<td>Post-operative F/U (yrs)</td>
<td>1.01</td>
<td>(0.97, 1.06)</td>
<td>0.459</td>
</tr>
</tbody>
</table>

#### Predicting Aesthetic Outcome

<table>
<thead>
<tr>
<th>Possible Predictors</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Dose (cGy)</td>
<td>1.00</td>
<td>(0.99, 1.00)</td>
<td>0.886</td>
</tr>
<tr>
<td>Radiation Boost (Y/N)</td>
<td>7.56</td>
<td>(0.44, 129.3)</td>
<td>0.016</td>
</tr>
<tr>
<td>Time from Radiation to Reconstruction (yrs)</td>
<td>1.16</td>
<td>(1.00, 1.33)</td>
<td>0.059</td>
</tr>
<tr>
<td>Post-operative F/U (yrs)</td>
<td>0.99</td>
<td>(0.94, 1.03)</td>
<td>1.03</td>
</tr>
</tbody>
</table>

### Conclusions

- The latissimus dorsi flap can facilitate prosthetic reconstruction in the setting of prior irradiation
- Incidence of major complications resulting in reconstructive failure is low
Conclusions

- Majority of patients had good/excellent aesthetic result and an acceptably low rate of capsular contracture
- Time from completion of radiation may help predict long-term outcomes

Delayed Reconstruction with Latissimus Flap

Pre-op
Reconstruction with Abdominal Flaps in the Radiated Patient
Reconstruction with Abdominal Flaps in the Radiated Patient

The GOLD Standard

Pre-op

Post-TRAM (6 months)
How do you improve the aesthetics?

Traditional Breast Conservation

- Lumpectomy
- ± Sentinel lymph node biopsy
- ± Axillary dissection
- ± Chemotherapy
- Whole breast irradiation
Recurrence after BCT

- Salvage mastectomy

Skin Sparing Mastectomy

- Periareolar incision
- Conservation of breast skin envelope
- Improved aesthetics
- Requirement for autologous tissue

Incision Patterns
Free TRAM favorable biopsy scar location

Free TRAM full and partial thickness necrosis of mastectomy skin flap

Muscle Sparing Free TRAM MS2
Free TRAM MS2

Full thickness skin flap necrosis
Free TRAM MS2

DIEP flap
• Flap harvested on single perforator
• Rectus muscle preserved
DIEP flap

• Microvascular anastomoses to internal mammary vessels
• 3rd rib cartilage removed for exposure

DIEP flap

• Primary closure of fascia without tension
• Interrupted 0 ethibond
Bilateral DIEP

*not so favorable biopsy scar location*

Bilateral DIEP

DIEP pre op
RTX on left
**DIEP after Nipple Areola reconstruction**

- Volume deficit
- Symmetry
- No radiation damage

**Local Recurrence after BCT**

- Volume deficit
- Asymmetry
- No radiation damage

**SSM – LD flap**

- Lat Dorsi Flap and silicone implant
- Contralateral reduction
SSM – LD flap

- Full thickness necrosis of margin of thin mastectomy flap
- Pigment change of skin flap
- Capsular Contracture

LD flap with Saline Implant

- Implant visibility
- Skin pigment changes
Conclusions

- Attention to quality of radiated skin (tattoo test)
- Anatomic location of recurrence
- Skilled breast surgeon

Conclusions

- Best results
  - Periareolar incision only
  - + axillary counter incision
  - TRAM, free TRAM, or DIEP reconstruction
- Worst results
  - latissimus dorsi + implant
Conclusions

Proper patient selection is paramount