Radiation Therapy for Skin Cancer

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Disclosures

No commercial or financial disclosures
Overview

• Indications for radiation therapy
• Radiation therapy considerations
  • Contraindications
  • Techniques
  • Dose/fractionation
• Case Examples
Optimal Treatment

• Goal of primary therapy is to cure the tumor and maximally preserve function and cosmesis
  • Superficial Therapy, Surgery, or Radiation

• Best results generally obtained with surgery
  • Control and cosmesis

• Consider function, cosmetic outcome, age, comorbidities, cost, treatment availability, and patient preference
Indications for Radiation Therapy:

- Squamous Cell Carcinoma
- Basal Cell Carcinoma
Indications for Radiation Therapy

SCC, BCC

- Definitive RT
  - Non-surgical candidates
    - Comorbidities, extent of disease
  - Areas where surgery would result in poor cosmesis or complex reconstruction (facial triangle, ears)
Indications for Radiation Therapy

SCC, BCC

- Adjuvant RT
  - Positive LN
    - Consider obs for 1 LN+ < 3 cm
    - Consider chemoRT for ECE or +margin in H&N
  - PNI
  - Recurrent disease
  - Positive margin
Indications for Radiation Therapy: Merkel Cell Carcinoma
Indications for Radiation Therapy

Merkel Cell Carcinoma

- Primary Site
  - **Definitive RT:**
    - Unresectable
    - Location, size, morbidity
  - **Adjuvant RT:**
    - All, regardless of margin

- LN
  - **Definitive RT:**
    - No SLNB or LND
  - **Adjuvant RT:**
    - -SLNB and at HR for false neg SLNB (prior surg, failure to perform appropriate IHC stain), operator error, H&N)
    - +SLNB
    - LND with > 1 LN+ or ECE
Indications for Radiation Therapy: Melanoma

- Superficial Spreading
- Nodular
- Lentigo Maligna
- Acral Lentiginous
**Indications for Radiation Therapy**

**Melanoma**

- **Primary**
  - Desmoplastic
  - Pos margin
  - Locally recurrent
  - > 4 mm + ulceration
  - > 4 mm + satellitosis

- **Lymph Nodes**
  - LDH < 1.5x ULN, and
  - ECE, or
    - Parotid: ≥ 1
    - Cervical: ≥ 2, or ≥ 3 cm
    - Axillary: ≥ 2, or ≥ 4 cm
    - Inguinal: ≥ 3, or ≥ 4 cm
  - Locally recurrent LN
  - SLN+, no CLND

**Palliative:** unresectable nodal, satellite, or in-transit disease
Radiation Therapy Considerations

- Contraindications
- Beam type and energy
- Technique
- Fractionation and Total Dose
Contraindications to Radiation Therapy

• Genetic conditions predisposing to skin cancer
  • Basal cell nevus syndrome
  • Xeroderma pigmentosum

• Relative contraindications
  • Connective tissue disorders
    • Scleroderma, Lupus
  • Tumors on hands/feet/genitalia
  • Previously irradiated sites
Radiation Therapy Considerations

- Contraindications
- Beam type and energy
- Technique
- Fractionation and total dose
Radiation Beam Type

- Superficial (35-60 kV)
- Orthovoltage (200-500 kV)
- Electrons (4-20 MeV)
- Megavoltage (4-25 MV)
Radiation Beam Type

- Protons and high energy photons (e.g. 20 MV) not ideal
  - Low skin surface dose
Electrons

Orthovoltage

100%
Bolus helps bring the 90-100% dose to the skin surface
Higher energy beam increases depth of dose distribution
Radiation Therapy Considerations

• Contraindications
• Beam type and energy
• **Technique**
• Fractionation and Total Dose
Technique Considerations

- Size
- Depth
- Contour
- Adjacent normal tissue
- Immobilization
Surface Lead Collimators and Eye Shields

- Collimator: sharpens field edge
- Lead eye shield: protects lens
Lens shield beneath eyelids

Lead collimation on skin surface
Immobilization
Immobilization
IMRT
Radiation Therapy Considerations

• Contraindications
• Beam type and energy
• Technique
• **Fractionation and Total Dose**
Dose
Fractionation/Time
Number of cells
Strandquist Plot

A: Skin necrosis
B: **Cure** of skin cancer
C: Moist desquamation
D: Dry desquamation
E: Erythema
Determinants of Effect on Normal Tissues

- Dose, fractionation, time
  - Prolonged fractionation associated with improved cosmesis
- Volume within treatment field
- Dose distribution
## RT Dose: Squamous Cell Carcinoma

### Tumor Diameter

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Examples of Dose Fractionation and Treatment Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2 cm</td>
<td>64 Gy in 32 fractions over 6–6.4 weeks</td>
</tr>
<tr>
<td></td>
<td>55 Gy in 20 fractions over 4 weeks</td>
</tr>
<tr>
<td></td>
<td>50 Gy in 15 fractions over 3 weeks</td>
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<tr>
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<td>35 Gy in 5 fractions over 5 days</td>
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<tr>
<td>≥2 cm</td>
<td>66 Gy in 33 fractions over 6–6.6 weeks</td>
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<tr>
<td></td>
<td>55 Gy in 20 fractions over 4 weeks</td>
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<tr>
<td></td>
<td>50 Gy in 20 fractions over 4 weeks</td>
</tr>
<tr>
<td></td>
<td>60 Gy in 30 fractions over 6 weeks</td>
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</tbody>
</table>

### Postoperative adjuvant

- 50 Gy in 20 fractions over 4 weeks
- 60 Gy in 30 fractions over 6 weeks

### Regional Disease: All doses at 2 Gy per fraction using shrinking field technique

- After lymph node dissection
  - Head and neck; with ECE:
  - Head and neck; without ECE:
  - Axilla, groin; with ECE:
  - Axilla, groin; without ECE:
- No lymph node dissection
  - Clinically (-) but at risk for subclinical disease:
  - Clinically evident adenopathy: head and neck:
  - Clinically evident adenopathy: axilla, groin:

### RT margin:
- < 2 cm: 1-1.5 cm
- > 2 cm: 1.5-2 cm
# Dose Fractionation Schemes

## Lesion Size: 1.5–2.0 cm

<table>
<thead>
<tr>
<th>Institution</th>
<th>Dose Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Princess Margaret Hospital</td>
<td>$7 \text{ Gy} \times 5 \ (113)$</td>
</tr>
<tr>
<td>University of Oregon</td>
<td>$3 \text{ Gy} \times 15 \ (92)$</td>
</tr>
<tr>
<td>University of Florida</td>
<td>$3 \text{ Gy} \times 15 \ (92)$ or $4 \text{ Gy} \times 10 \ (96)$</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>$7 \text{ Gy} \times 5 \ (113)$ or $5 \text{ Gy} \times 8 \ (108)$</td>
</tr>
<tr>
<td>University of Alabama</td>
<td>$9 \text{ Gy} \times 5 \ (167)$</td>
</tr>
<tr>
<td>Christie</td>
<td>$10 \text{ Gy} \times 3 \ (123)$ or $20 \text{ Gy} \times 1$</td>
</tr>
<tr>
<td>MGH</td>
<td>$9 \text{ Gy} \times 5 \ (167)$ or $5 \text{ Gy} \times 9 \ (123)$</td>
</tr>
<tr>
<td></td>
<td>$4 \text{ Gy} \times 13 \ (125)$</td>
</tr>
<tr>
<td></td>
<td>$20–23 \text{ Gy} \times 1 \ (rarely \ used)$</td>
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## Lesion Size: 5.0–6.0 cm

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<tr>
<td>PMH</td>
<td>$3 \text{ Gy} \times 20$ or $4 \text{ Gy} \times 10$</td>
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<tr>
<td>University of Oregon</td>
<td>$3 \text{ Gy} \times 20$ plus implant</td>
</tr>
<tr>
<td>University of Florida</td>
<td>$3 \text{ Gy} \times 20$</td>
</tr>
<tr>
<td>University of Arizona</td>
<td>$1.8 \text{ Gy} \times 35$</td>
</tr>
<tr>
<td>University of Alabama</td>
<td>$3 \text{ Gy} \times 20$ plus implant $35 \text{ Gy}$</td>
</tr>
<tr>
<td>Christie</td>
<td>$35 \text{ Gy}$ plus implant</td>
</tr>
<tr>
<td></td>
<td>Implant to $60 \text{ Gy}$ alone</td>
</tr>
<tr>
<td>MGH</td>
<td>$4 \text{ Gy} \times 13$ or $3 \text{ Gy} \times 20$</td>
</tr>
<tr>
<td></td>
<td>$3 \text{ Gy} \times 10$ plus implant</td>
</tr>
<tr>
<td>Tumor Diameter</td>
<td>Margins</td>
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<tr>
<td>----------------</td>
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</tr>
<tr>
<td>&lt;2 cm</td>
<td>1–1.5 cm¹</td>
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<td>Postoperative adjuvant</td>
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RT Dose: Merkel Cell Carcinoma

• Definitive RT:
  • Gross disease (primary or clinically +LN): 60-66 Gy
  • Clinically -LN, no SLNB or LND: 46-50 Gy

• Adjuvant RT
  • Neg margin 1°: 50-56 Gy
  • Microscopically +margin 1°: 56-60 Gy
  • +margin or gross disease, 1°: 60-66 Gy
  • SLN+: 50-56 Gy
  • After LND: 50-60 Gy

*Start RT ASAP, delay associated with worse outcomes
*2 Gy/day, 5-6 weeks total
RT Dose: Melanoma

• Primary site
  • 30 Gy/5 fractions, biweekly, 2.5 weeks
  • 32 Gy/4 fractions, biweekly, 3 weeks
  • 50 Gy/20 fractions, daily, 4 weeks

• LN region
  • 30 Gy/5 fractions, biweekly, 2.5 wks
  • 48 Gy/20 fractions, daily, 4 wks
Case Examples
3 years after 4250 cGy in 10 fractions
2 months after 4500 cGy in 10 fractions
1. Prior to treatment
2. @ 2400 cGy
3. @ 6000 cGy
4. 1 month after XRT
2 month s/p 4400 cGy
2 mo after 4500 cGy in 15 fractions
Summary

- Radiation therapy can be used
  - Definitively for unresectable tumors, non-surgical candidates, or tumors in locations where surgery would be too morbid
  - Post-operatively for high risk features

- Total dose and fractionation depend on histology, location, importance of cosmesis, patient comorbidities, and patient preference

- Good results necessitate proper technique