Below and Beyond Skin Deep: Challenges, Solutions, and Lessons from Advanced Skin Cancers of the Head and Neck

Julie Jung Kang, MD PhD
Kaiser Permanente Department of Radiation Oncology
October 7, 2016
AAMRD Region I Conference Las Vegas, NV
Disclosures

• I have no disclosures to report.
The most common cancer in the United States is...

**SKIN CANCER**

1 in 5 Americans will develop skin cancer in their lifetime.

~700,000 new cases of squamous cell carcinoma (SqCC) of the skin are diagnosed in the U.S. each year.

SqCC tends to develop on skin that has been exposed to the sun.
Cutaneous SqCC of the H&N

- represent 25% of non-melanomatous skin cancers
- ↑ incidence with proximity to the Equator

300 people per every 100,000 in Australia
compared to
~120 per 100,000 for breast cancer in US
~150 per 100,000 for prostate cancer in US
TREATMENT OF SKIN CANCER

- Radiation
- Surgery
- Chemotherapy
The Role of Radiation Therapy in Head and Neck Skin Cancers

- Locally advanced disease.

- For organ preservation in areas such as the central face.

- Patients with medical contraindications to surgery.

- Adjuvant setting to improve tumor control in often surgically inaccessible areas (like the skull base in instances of perineural invasion).

Going where the scalpel will not go
Going where the scalpel cannot go
Learning Objectives

• To review basic anatomy relevant to clinical target volume and organ-at-risk delineation for skin cancers of the head and neck.

• To discuss common challenges in treatment planning and delivery.

• To review lessons learned from complex real-life cases.
The **layers of the scalp** are as follows:

A, hair bearing;  
B, subcutaneous tissue;  
C, frontalis muscle and galea aponeurotica;  
D, periosteum;  
E, cranium;  
F, temporalis muscle;  
G, deep temporalis fascia;  
H, loose areolar tissue;  
I, temporoparietal fascia with superficial temporal vessels.

Hair-Bearing Temporoparietal Fascial Flap Reconstruction of Upper Lip and Scalp Defects. Jennifer C. Kim, MD; Tessa Hadlock, MD; Mark A. Varvares, MD; Mack L. Cheney, MD. *Arch Facial Plast Surg.* 2001;3(3):170-177.
ANATOMY

Superior Oblique (CN IV)
Superior Rectus (CN III)
Medial Rectus (CN III)
Lateral Rectus (CN VI)
Inferior Rectus (CN III)
Inferior Oblique (CN III)

Anterior chamber (aqueous humour)
Posterior chamber
Suspensory ligament of lens
Sclera
Vitreous humour
Hyaloid canal
Retinal blood vessels
Optic nerve
Retina
Macula
Fovea
Optic disc
Uvea
Iris
Ciliary body
Choroid
ANATOMY

- Glabella
- Bridge
- Dorsum Nasi
- Alar groove
- Nasal Ala
- Nasolabial Fold
- Columna
- Philtrum
Cranial Nerves and their Skullbase Foramina

I: Cribriform Plate
II: Optic Canal
III: Superior Orbital Fissure
IV: Superior Orbital Fissure
V1: Superior Orbital Fissure
V2: Foramen Rotundum
V3: Foramen Ovale
VI: Superior Orbital Fissure
VII: Internal Acoustic Meatus
VIII: Internal Acoustic Meatus
IX: Jugular Foramen
X: Jugular Foramen
XI: Jugular Foramen
XII: Hypoglossal Canal
Optic Nerve vs. Superior Rectus
Diagrammatic view. The vitreous humor is illustrated only in the bottom part of the eyeball.
Cranial Nerve Anatomy: V1 Ophthalmic

- Supraorbital nerve
- Supratrochlear nerve
- Infratrochlear nerve
- Lacrimal nerve
- External nasal nerve
- Internal nasal nerve
- Maxillary nerve (V2)
- Mandibular nerve (V3)
- Ophthalmic nerve (V1) of trigeminal nerve
- Nasociliary nerve
- Anterior ethmoidal nerve
- Sphenoidal sinus
- Posterior ethmoidal air cells
- Frontal nerve
- Supraorbital nerve
- Supratrochlear nerve
- Infratrochlear nerve
- Lacrimal nerve
- Lacrimal gland

Key:
- V1: Ophthalmic
- V2: Maxillary
- V3: Mandibular
V1 Ophthalmic Nerve: Superior Orbital Fissure vs. Optic Canal
Cranial Nerve Anatomy: V2 Maxillary

Maxillary Nerve

Schematic (lateral view)

Lacrimal Gland
Skin over temple
Skin over cheekbone

Inferior Orbital Fissure
Sphenopalatine Foramen
Infraorbital canal
Infraorbital foramen

CNV1
CNV2
Zygomatic n.

Foramen Rotundum
Pterygopalatine ganglion

V2

Trigeminal Ganglion

Nasopharynx
Pharyngeal Branches

Nasal Cavity
Nasopalatine Nerve

Teeth / Gingiva (superior)
Incisive Foramen
Soft palate
Greater Palatine Nerve

Lesser Palatine Nerve
Palatine Foramen
Hard Palate

Foramen Rotundum
Pterygopalatine ganglion
V2 Foramina... Foramen Rotundum
Cranial Nerve Anatomy: V3 Mandibular
V3 Foramina: Foramen Spinosum
Cranial Nerve Anatomy: VII Facial

Temporals
Zygomatic
Buccal
Mandibular
Cervical
Posterior Auricular

Anterior
masseteric nerve

Deep temporal

Bucaal nerve

Posterior

Auriculo-temporal nerve

Lingual nerve

Inferior alveolar nerve

Mylohyoid nerve
Facial Nerve Course
Facial Nerve or Cochlea?
Radiation Principles

The RT target volume typically encompasses the visible or palpable tumor and 1 to 2 cm of surrounding normal-appearing skin. Margins may be tighter close to the eye or when the primary lesion is ≤1 cm.

Longer schedules using lower dose (2 to 2.5 Gy) per fraction gives the best cosmetic results.

For older patients, <1 cm can consider: 40 Gy in 10 fractions, 20 Gy in 1 fraction.
Tumor ≤2 cm: 50 Gy in 20 fractions.
Large tumor or cosmetic concerns: 60 Gy in 30 fractions (up to 66 Gy with infiltrative tumors)
Postop RT to LNs if >1 LN+ or +ECE: 60 Gy in 30 fractions

Perineural Invasion (PNI): 60 Gy to the distal course of the nerve, 50 Gy to the proximal course

Consider postop RT to the Primary Site: size, location, poor border definition, recurrent tumor, immunosuppression, site of prior radiation, rapid growth, neurologic symptoms, adegnosquamous, desmoplastic, Clark Level IV/V, thickness≥ 4 mm, PNI, LVI.

If doing postop RT for +LN or PNI, consider encompassing the primary tumor bed if feasible.

Electively treating regional LNs in patients with PNI is an option but probably unnecessary.

Sometimes PTV V100=100% is not feasible. Consider → PTV V100 ≥ 95% or CTV V100 ≥ 99%
Practical Applications of Anatomy to Caring for Real Patients
Case VD: Lip/Nose

• 62F with Lynch Syndrome and a rapidly-growing T2N0 high-risk SqCC of the RIGHT upper lip with extension into the nasal septum/vestibule/ala and submucosa of the upper lip, with +prominent PNI, resected with -margins on Mohs.

• At consultation, she reported RIGHT upper lip/nasolabial/upper cheek numbness and buzzing (+clinical PNI of CN V2).
Case VD

In the process of planning the radiation therapy, she developed new onset of LEFT upper lip/nasolabial fold numbness and noticed new cutaneous papules near her right upper lip scar and on the left upper lip near the nasolabial fold.
Case VD: Lip/Nose

- 10/15/2015-12/1/2015, +concurrent cisplatin. Daily kV/kV to base of skull and orbit.
- Facial Skin (upper lip mustache field, inferior nose, upper cheek) + Gross Perineural Seeding on RIGHT CN V2, 6600 cGy/30 fractions at 220 cGy/fraction, 9-field IMRT/SIB + daily 5 mm bolus, + custom stent.
- CN V2 in base of skull (bilateral face, infraorbital foramen/pterygopalatine fossa), 6000 cGy/30 fxs.
- CN V2 adjacent to brainstem (bilateral skullbase, cavernous sinus, Meckel’s cave), 5400 cGy/30 fxs.
Case DW: Scalp

- 80 year old male with PMH significant for CLL and ESRD on hemodialysis, with multiple skin cancers over the scalp (vertex, forehead, preauricular skin).

- He had a multiply recurrent SqCC of the skin of the parietal scalp (+PNI) which required a full-thickness skin graft … which failed.

- He now has dermal lymphatic spread to multiple spots over the bilateral frontaoparietal/occipital scalp.

- He keeps noticing new bumps all over his scalp (right scalp, near and away from the other lesions, a new lesion over his left eyebrow that started about 2 weeks ago).
Scalp PTV
Total dose: 6000 cGy in 200 cGy fractions with daily custom bolus
**DW: Scalp**

Mean Brain Dose: 3839 cGy
BK: Scalp

63 F well-diff SqCC of vertex scalp (pT2Nx, +PNI, -margins, +tumor to periosteum), s/p full-thickness skin graft + adjuvant RT in 3/2016.

Partial Scalp PTV.
6000 cGy/30 fractions.
6-field IMRT.
No bolus (because of graft).
Mean Brain Dose: 1855 cGy
PET 4/16/2016
Indications for Management of the Neck

**Supraomohyoid Neck Dissxn (SOHND) + Parotidectomy**
- Cervical LND with preservation of one or more LN groups
- SOHND: En bloc removal of level I-III cervical lymph node groups; Inferior limit is the omohyoid muscle overlying the IJV
- **Indications:** Cutaneous SqCC of cheek, Stage I melanoma cheek (1.5-3.99 mm)

**Selective Neck Dissxn (SND): Posterolateral Type**
- En bloc excision of LN bearing tissues in Levels II-IV and additional node groups--suboccipital and postauricular
- **Indications:** Cutaneous malignancies (Melanoma, SqCC, Merkel cell, STS scalp/neck)

*Rate of occult metastasis in clinically negative neck 20-30%*

**Indication:** primary lesion with 20% or greater risk of occult metastasis
## Lymph Node Metastasis Risk Factors

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Metastatic likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size $&gt;2\text{ cm}$</td>
<td>20–30%</td>
</tr>
<tr>
<td>Invasion into subcutaneous fat (depth $\geq 5\text{ mm}$)</td>
<td>16–45%</td>
</tr>
<tr>
<td>Poorly differentiated/metatypical/morphephorm phenotype</td>
<td>12–32%</td>
</tr>
<tr>
<td>High grade or desmoplasia</td>
<td>12%</td>
</tr>
<tr>
<td>Perineural invasion</td>
<td>40–47%</td>
</tr>
<tr>
<td>Lymphovascular invasion</td>
<td>40%</td>
</tr>
<tr>
<td>Location near parotid (ear, temple, forehead, anterior scalp) or lip</td>
<td>10–30%</td>
</tr>
<tr>
<td>Local recurrence</td>
<td>25–62%</td>
</tr>
<tr>
<td>SCC in preexisting scar (burn or trauma)</td>
<td>38%</td>
</tr>
<tr>
<td>Immunosuppression</td>
<td>13–20%</td>
</tr>
</tbody>
</table>

She had bilateral neck dissections + LEFT postauricular skin excision (+1 LN in RIGHT Level 5, +3 LNs in LEFT Level 2B, +left postauricular skin lesion).

Received adjuvant RT.
- 6000 cGy/IMRT 17 beams.
- PTV: Left postauricular resection bed, Bilateral level 2-5 neck up to BOS, Bilateral SCV/parotids.
- with concurrent cisplatin.
95 year old female with locally advanced, ulcerated SqCC of the skin of the LEFT ear with extension into the EAC and into the temporal bone (likely T3). Her power of attorney (nephew) declined surgical resection and requested palliative radiation. She has severe dementia.

Definitive RT to the Left Ear. Dose 5500 cGy in 22 fractions, @250 cGy/fraction. Treated from 1/5/2016 to 2/8/2016. 35 days. Technique: RAO/LPO, 6 MV, +daily bolus under mask.
Case EO: Ear

Post-RT picture 3/2/2016
Case RS: Ear

- 80 yo M cT3N0 poorly-differentiated SqCC of the RIGHT ear/cheek/scalp.
- He is not a candidate for surgery.
- He also has severe dementia.
- Definitive RT to the Right ear/cheek.
  - 6600 cGy/33 fractions @200 cGy/fraction.
  - +concurrent Erbitux.
  - Treated 3/15/2016 to 6/8/2016. 86 days.

- Treatment breaks:
  - He missed four weeks after first fraction due to S. Aureus sepsis.
  - He had decline in performance status after MICU admission for sepsis and was not able to come consistently to treatments.
Case RS: Ear

2/15/2016

Post-RT 7/14/2016
Success vs. Failure

T3N0: 50 Gy/20 fxs

T3N0: 66 Gy/33 fxs + Erbitux

5 Weeks vs. 12 Weeks
65 M with ESRD (on hemodialysis, s/p amputation, s/p right retinal hemorrhage with vision loss), who presented with a left temple lesion. It was excised and showed SqCC of the skin (T2Nx). He had poor wound healing and a graft was placed, but failed. He was referred for definitive RT.
Left Eyebrow/Temple/Eyelid: 6000 cGy/30 fractions, +daily 0.5 cm bolus and eye shield.
Left Parotid/Neck: 5400 cGy/30 fractions.
DO: Eye MRI Orbits 5/23/2016

Abnormal 3.4 x 2.2 x 1.7 cm mass in the superior orbit, which may involve the superior and medial rectus muscles, secondary to metastatic disease. Left supraorbital soft tissues is also concerning for recurrent disease. Choroidal detachment.
Was it there before? CT SIM 12/9/2015
40M with T4aN2b desmoplastic melanoma of LEFT eye s/p WLE + parotidectomy + neck dissxn + 48Gy to the LEFT parotid bed/neck/SCV in 2011. He developed recurrence requiring craniofacial resection (+tumor fixed to dura, +extension along roof of orbit into frontal sinus, +gross PNI along left supraorbital nerve, +likely microscopic residual disease, -BRAF).

PET 11/2/2015: destructive soft tissue mass involving left frontal sinus bone (SUVmax 8.2).

MRI 10/29/2015: enhancing mass in left supraorbital region with underlying frontal calvarium destruction and perineural extension along left supraorbital nerve and V1.
DH: Eye

PTV Resection Bed/CN V1 course: 6000 cGy @ 200 cGy/fxs
PTV2 high-risk near chiasm/brainstem/retina: 5400 cGy @ 180 cGy/fx.

TECHNIQUE: IMRT/SIB + 0.5cm daily bolus. 9-field IMRT. Daily kV/kV, line up to skull base

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optic Nerve</td>
<td>4992 cGy</td>
<td>5327 cGy</td>
</tr>
<tr>
<td>Chiasm</td>
<td>5132 cGy</td>
<td>5319 cGy</td>
</tr>
<tr>
<td>Retina</td>
<td>4402 cGy</td>
<td>5348 cGy</td>
</tr>
</tbody>
</table>
DH: Eye

~1/20/2016

Post-RT 5/5/2016
CN V2/Maxillary Nerve Interconnections with Facial Nerve

Figure 4  Schematic diagram of the internerve connections between cranial nerves [CN] V₂ and VII in the vicinity of the hard palate. Inset: A computed tomographic (CT) scan demonstrating the vidian canal (white arrowheads), where these 2 nerves communicate as the vidian nerve.
CN V3/Mandibular Nerve Interconnections with the Facial Nerve

Ko HC, Gupta V, Mourad WF, Hu KS, Harrison LB, Som PS, Bakst RL.
A contouring guide for head and neck cancers with perineural invasion.
*Practical Radiation Oncology.* 2014; 4:c247-c258.
Thank you for your time!
Thank you AAMMD for the opportunity to come speak!

Acknowledgements:

Mary Ann Hagio, CMD
Sherrie Alexander, CMD
Tony Bardwell, CMD
Eric Banes, CMD
Larry Lin, MS

Questions?