

# Adenoid Cystic Carcinoma (ACC) of the Head and Neck

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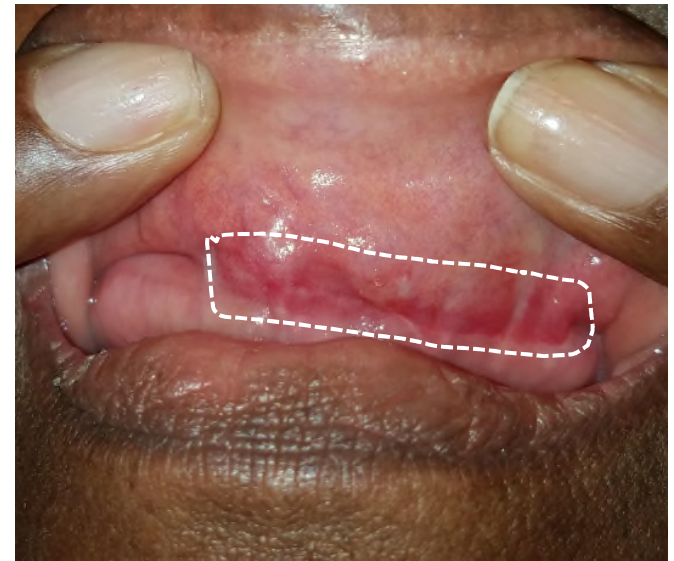
Gainesville, FL

# Outline

- Case
  - Clinical Presentation
  - Workup/Diagnosis
  - Management
    - Surgery
    - Adjuvant radiation
      - CT simulation
      - Target delineation
      - Plan evaluation
  - Follow-up
- Background
- Workup
- Management
  - Surgery
  - Radiation
    - Postop vs definitive
    - Target selection
      - Cranial nerve coverage
      - Elective nodal RT
    - Modalities
      - Chemotherapy
- Future Directions

# Case: Clinical Presentation

- **HPI:** 65-year-old man referred to ENT for painful, enlarging oral cavity mass along upper gum (over 3-4 months)
- **ROS:** No bleeding, neck masses, weight loss, formication, numbness, tingling, or weakness
- **SH:** No history of tobacco or alcohol use
- **PMH, PSH, meds/allergies, FH** otherwise non-contributory
- **Physical exam:** 3.5cm submucosal mass, along gingivobuccal sulcus of left maxillary alveolar ridge, crosses midline
  - No palpable facial, submental, submandibular, cervical, or supraclavicular adenopathy
  - Cranial nerves II – XII intact
  - Maxillary dentition absent; mandibular teeth present and without decay
  - No other oral lesions, ulcers, or evidence of bleeding



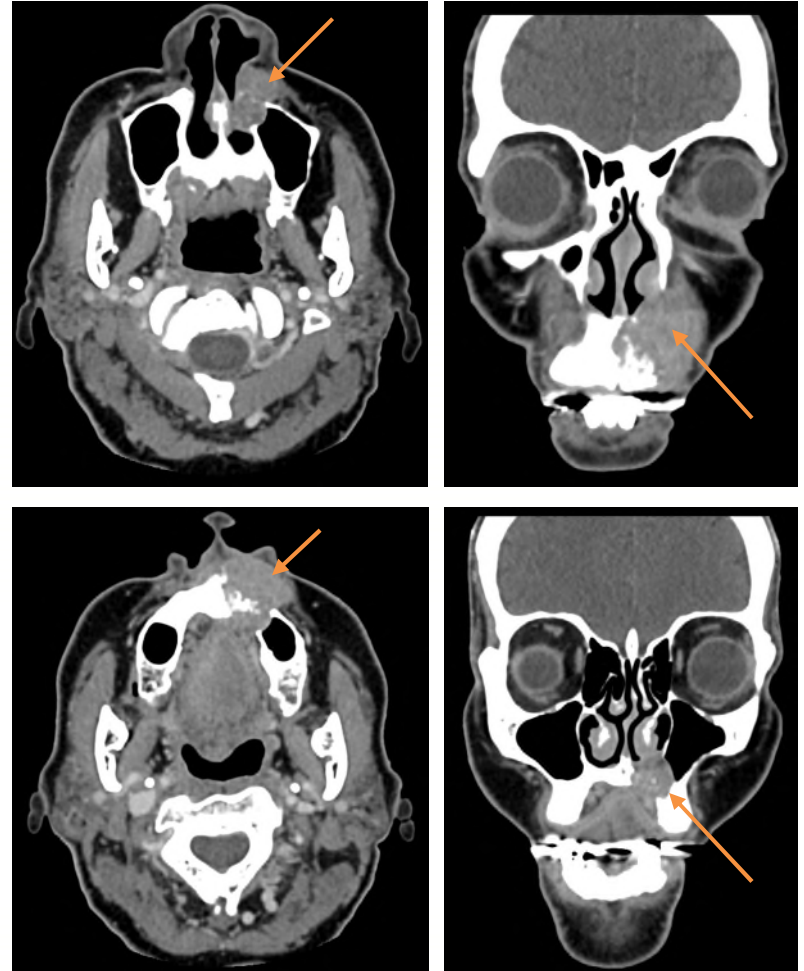
# Case: Diagnostic Workup

- ENT performed **flexible nasopharyngolaryngoscopy**
  - Submucosal mass extends into left nasal cavity to inferior turbinate.
  - Remainder of visualized right nasal cavity, nasopharynx, oropharynx, hypopharynx and larynx without abnormalities
- **Biopsy** of gingival mass: **+Adenoid cystic carcinoma**
  - Predominantly cribriform pattern (Grade 2)

Grade	Spiro System (Am J Surg 1974)	Szanto System (Cancer 1984)
1	Typical cribriform pattern exclusively	Tubular and cribriform areas without solid components
2	Cribriform pattern about equally mixed with solid areas (showing basaloid or anaplastic features)	Pure cribriform pattern or mixed with <30% solid areas
3	Basaloid or anaplastic features predominantly	Predominantly solid pattern (>30%)

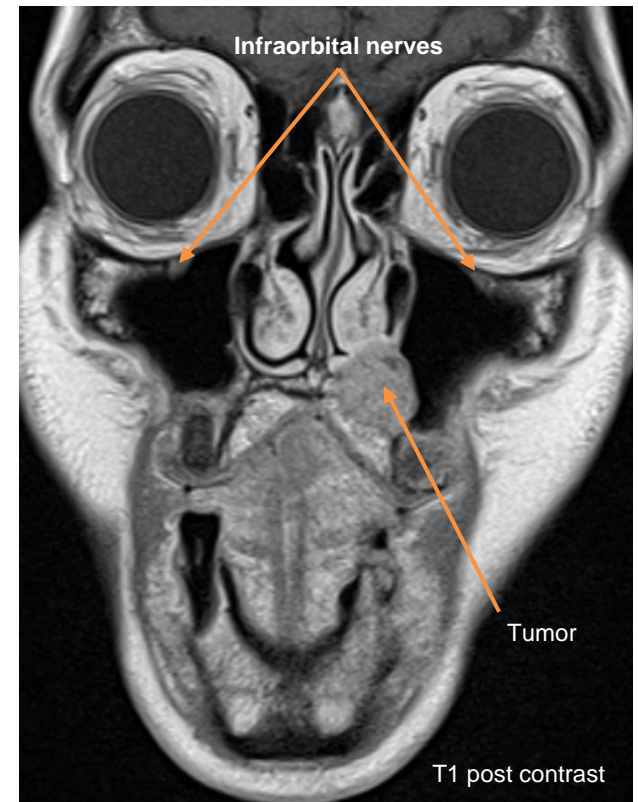
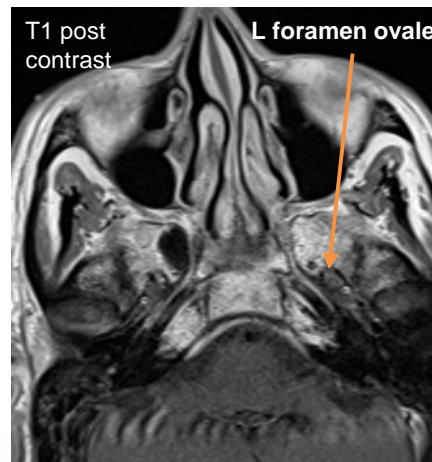
# Case: Diagnostic Workup

- **CT max/face with IV contrast:**
  - Infiltrative mass centered in region of left premaxilla, 3.8cm
  - Involves left nasolabial fold and protrudes into inferior nasal cavity
  - Gross bone invasion of premaxilla, ~1cm extension beyond midline
  - Extends slightly into maxillary sinus
  - No orbital involvement
  - No facial, cervical, or parotid adenopathy
- **CT Chest:** no distant mets



# Case: Diagnostic Workup

- **MR face, oral cavity, orbit without/with IV contrast:**
  - Mass extends superiorly into superficial musculoaponeurotic system of face
  - No definite evidence of PNI
    - No extension along infraorbital or mental nerve
  - Cavernous sinus appears normal

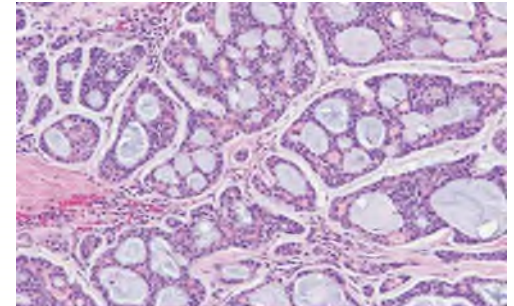


# Case: Initial Management (Surgery)

- **Head and Neck Multidisciplinary Tumor Conference** recommended primary surgery and postop RT
- First, en bloc tumor resection was performed via lateral rhinotomy incision
  - Left maxillectomy, total ethmoidectomy, skull base dissection, midface reconstruction, orbital preservation
  - Right fibular osteocutaneous free flap; dental implants placed (x4)
  - Left suprahyoid neck dissection

# Case: Surgical Pathology

- Adenoid cystic carcinoma, 4.5 x 2.3 x 2.2 cm
  - Cribriform pattern, 20% solid component
  - Unifocal tumor involving premaxilla, anterior maxilla, palate, maxillary sinus, nasal cavity
  - Microscopic perineural invasion present, focal, involving small-caliber nerves (<0.1mm)
    - No malignancy identified in the portion of V2 excised with resection margins
  - No LVSI
  - Multiple specimen margins involved by invasive tumor
    - All separately submitted margins uninvolved
- 0/2 lymph nodes involved (left level 1B)



<https://www.nature.com/articles/modpathol200995.pdf>

AJCC 8<sup>th</sup> Edition  
Overall Pathologic  
Stage IVA (pT4a N0 M0)

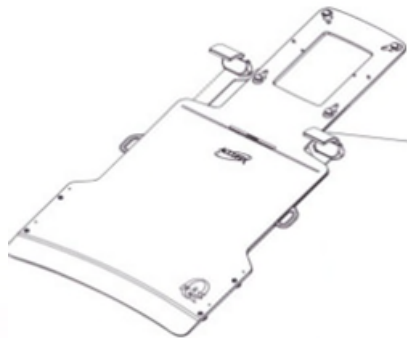


# Case: Postoperative Course

- Appx 2-3 weeks postop, he developed L nasolabial dehiscence: 2x2cm area of nonviable, infected tissue
  - Initially managed with p.o. antibiotics
- He was taken back to OR (5 weeks after primary surgery) for debridement and surgical revision of partial free flap loss
  - Skin paddle of Fibula Free Flap was non-viable
  - Underlying fascia and bone were viable
  - He developed minor oral-nasal fistula
- Adjuvant radiation start delayed until ~ 8 weeks postop

# Case: Adjuvant Radiation

- CT simulation:
  - **Position:** Supine, arms at side, shoulders down, head extended
  - **Immobilization:** thermoplastic Aquaplast head mask, AccuFix board with shoulder depression mechanism and hand bars
  - **Bolus:** 5mm along surgical scar of left face
  - **Additional instructions:**
    - IV contrast
    - Oral stent (to move lower jaw inferiorly, away from treatment field)
    - Fuse CT images with postop MRI Head, T1+C



# Case: Adjuvant Radiation

## RT Volumes:

1. **CTV1** = **CTV2** + CNV2 to foramen rotundum + CNV3 to foramen ovale + CN VII to stylomastoid foramen + skull base/low cavernous sinus. **No elective nodal irradiation.**
2. **CTV 2** = tumor bed + 5mm, edited for boundaries to tumor spread
3. **PTV1** = **CTV1** + 3mm
4. **PTV2** = **CTV2** + 3mm

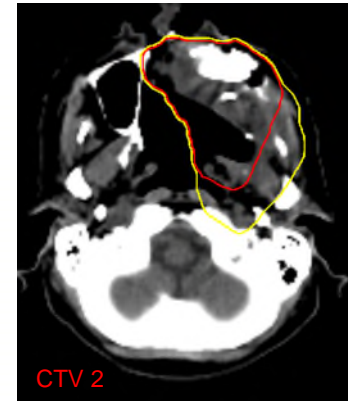
## RT Prescription:

**PTV1:** 52.8 Gy at 1.6 Gy per fraction, QD

**PTV2:** 66 Gy at 2 Gy per fraction, QD

Total fractions: 33

Total treatment days: 33



**Concurrent chemo:** No

**Technique:** IMRT SIB

**Beam Energy:** 6MV photons

**IGRT:** CBCT prior to each fx

**Bolus:** 5mm to facial incision

RT Rx:

PTV1: 52.8 Gy

PTV2: 66 Gy

# Case: Adjuvant Radiation

## IMRT Isodose Plan (6MV photons)

Shaded Volumes:

PTV1

PTV2

Isodose lines (IDL)

White IDL: 105% rx

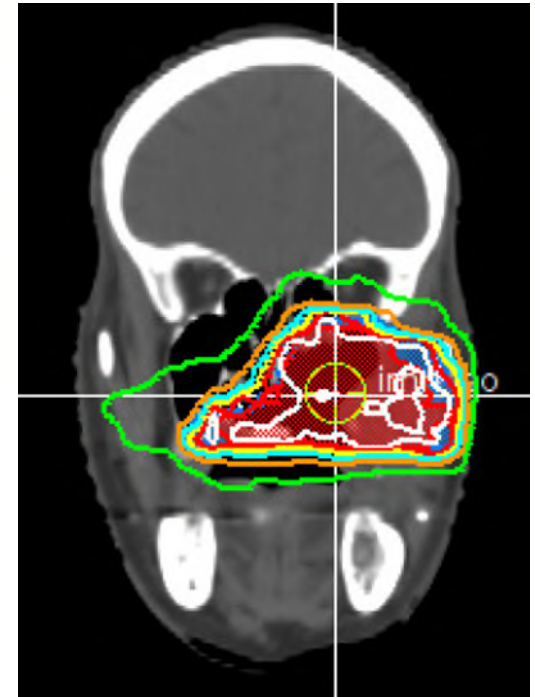
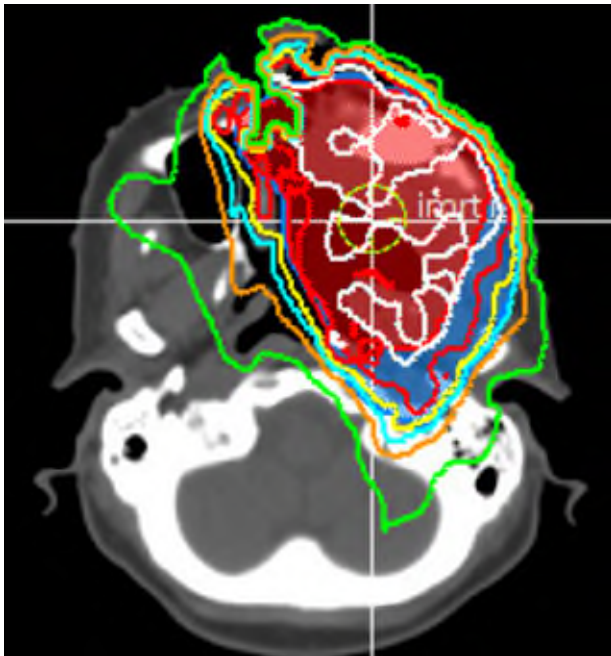
Red IDL: 100% rx

Yellow IDL: 95% rx

Cyan IDL: 90% rx

Orange IDL: 80% rx

Green IDL: 50% rx



Where “rx” refers to **PTV2** prescription dose (66Gy). Therefore, 80% rx (orange IDL) = **PTV1** prescription dose ( $0.8 \times 66 \text{ Gy} = 52.8 \text{ Gy}$ )

# Case: Adjuvant Radiation

Target Coverage Goals/ Heterogeneity Constraints			Major OAR Constraints		
Structure	DVH Point	Objective	Structure	DVH Point	Objective
PTV	D95%	$\geq 100\%$ Rx	Brainstem	D0.1cc	$\leq 55$ Gy
PTV	D99%	$\geq 93\%$ Rx	Cochlea_L	Mean dose	Primary < 36 Gy Secondary < 45 Gy
PTV	V110% Rx	< 20%	Parotid_L	Mean dose	< 26 Gy
PTV	D0.03cc	Primary < 110% Rx Secondary < 115% Rx	Spinal Canal	D0.1cc	$\leq 50$ Gy
<p><b>Met primary objective</b></p> <p><b>Met secondary objective</b></p> <p><b>Did not meet objective</b></p>			Retina_L	D0.1cc	$\leq 50$ Gy
			Brain	V74Gy	$\leq 2$ cc
			Lacrimal Gland_L	Mean dose	Primary < 34 Gy Secondary < 41 Gy
			Temporal Lobe_L	V74Gy	$\leq 2$ cc

# Case: Follow-up

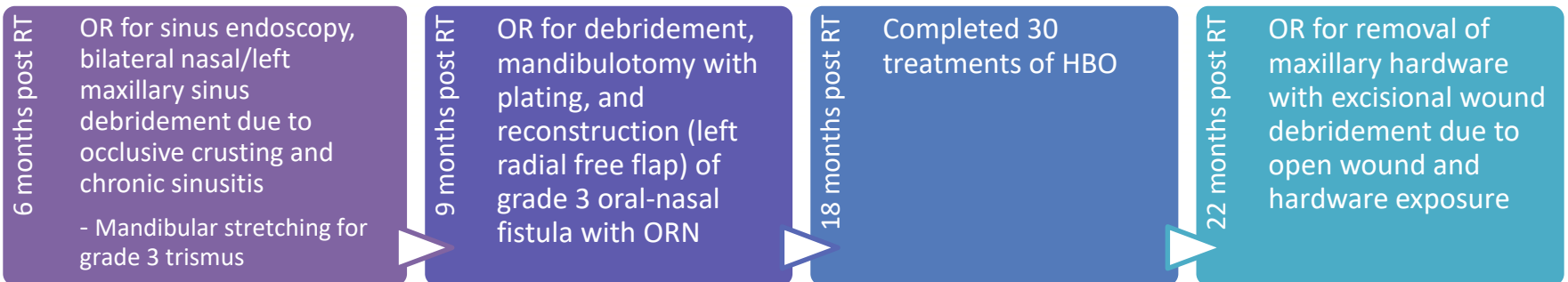
Common Terminology Criteria for Adverse Events (CTCAE) v5.0  
Publish Date: November 27, 2017

## Treatment Course:

- By the end of RT, he developed grade 3 dysphagia, grade 3 oral mucositis, and grade 2 weight loss requiring opioids for pain, feeding tube placement, and hospitalization (10 days) for failure to thrive
  - Hospitalization/G-tube placement occurred just after RT completion

## Post-RT Follow-up:

- Followed q3mo by ENT with head and neck exam and nasal endoscopy



## Now 3 years since RT: NED (exam, CT maxface/neck and chest)

- Significant asymmetry, grade 3 fibrosis, and grade 1 hyperpigmentation of midface
- Still 100% G tube dependent (since end of RT)

# Outline

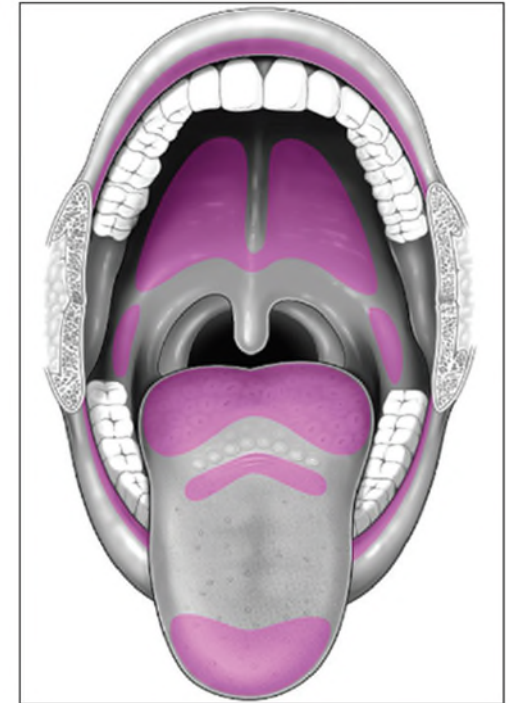
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# Adenoid Cystic Carcinoma (ACC): The Basics

- Rare type of adenocarcinoma
  - 1,300 cases/yr in US, M:F 2:3, ↑50-60 y.o.
  - Most relevant studies are small, retrospective
- Most commonly arises in major and minor salivary glands of head and neck
  - Also can develop in lacrimal glands, ceruminous glands, larynx, trachea, paranasal sinuses, etc.
- Symptoms depend on tumor location
  - Often painless mass in head/neck
  - Neuro deficit indicates advanced disease
- Tendency for PNI and hematogenous spread to distant organs

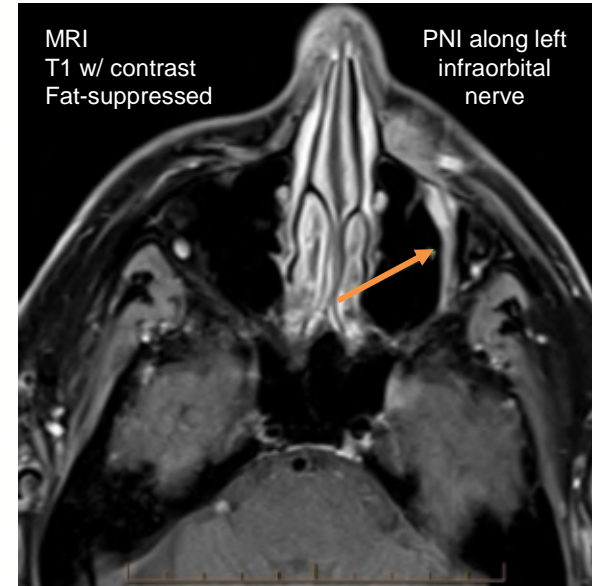


Minor salivary glands of the oral cavity  
DOI: [10.4103/jcis.JCIS\\_45\\_18](https://doi.org/10.4103/jcis.JCIS_45_18)



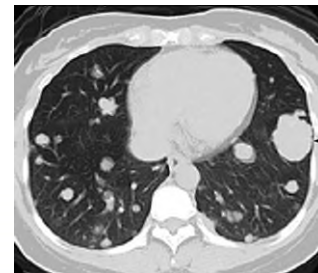
# Background: Clinical Course

- Locally aggressive
  - Grade determined by growth pattern
    - Grade I (predominantly tubular), Grade II (predominantly cribriform), Grade III (solid > 30 %)
  - T4: ~30-50%
  - +PNI: ~50-70%
  - Limited nodal spread (<10%)
- Indolent, but often aggressive course
  - High rates of survival (5y OS: ~80%, 15y OS: ~40%), but most pts progress
  - Followup should continue >15 years, if possible
- Most common site of DMs: lungs
  - Other sites of DMs: liver, brain, bone
  - DM is most common type of disease progression (>1/3)



<https://radiopaedia.org/articles/perineural-spread-of-tumour>

Thariat et al., 2008



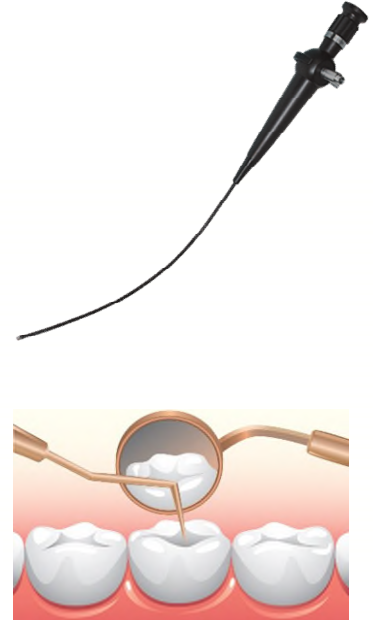
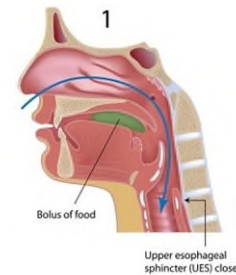
Yeung et al., 2009



# Diagnostic Workup

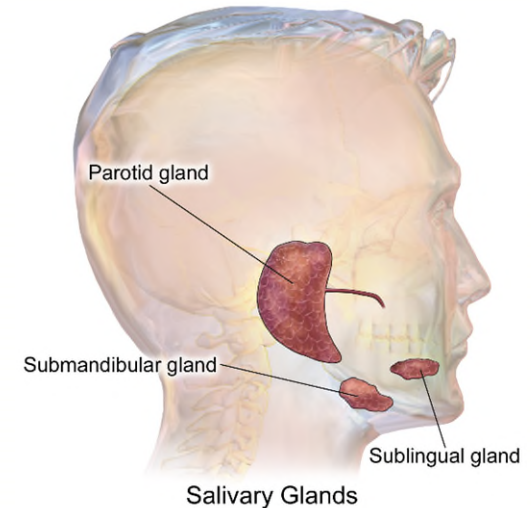
## NCCN Guidelines Version 3.2021 Salivary Gland Tumors

- Complete head and neck exam (+ fiberoptic examination)
- FNA or core needle biopsy
- CT and MRI with contrast of skull base → clavicles
  - MRI is best radiographic study to evaluate PNI
- CT Chest (with or without contrast)
- Dental evaluation
- Preanesthesia studies (preop assessment)
- Nutrition and speech/swallowing evaluation
- Multidisciplinary evaluation
- Baseline eye, audiometry, and/or neuroendocrine function evaluation, when pertinent



# How to Stage (AJCC 8<sup>th</sup> Edition)

- Primary tumor located in **major** salivary gland: refer to “Major Salivary Glands” chapter in “Head and Neck” section (or see next slide)
- Primary tumor located in **minor** salivary gland or other glandular organ: refer to relevant site chapter, often in “Head and Neck” section
  - Ex: ACC of hard palate → “Oral Cavity”



[https://en.wikipedia.org/wiki/Salivary\\_gland](https://en.wikipedia.org/wiki/Salivary_gland)

# AJCC 8<sup>th</sup> Edition Staging: Major Salivary Glands (Parotid, Submandibular, Sublingual)

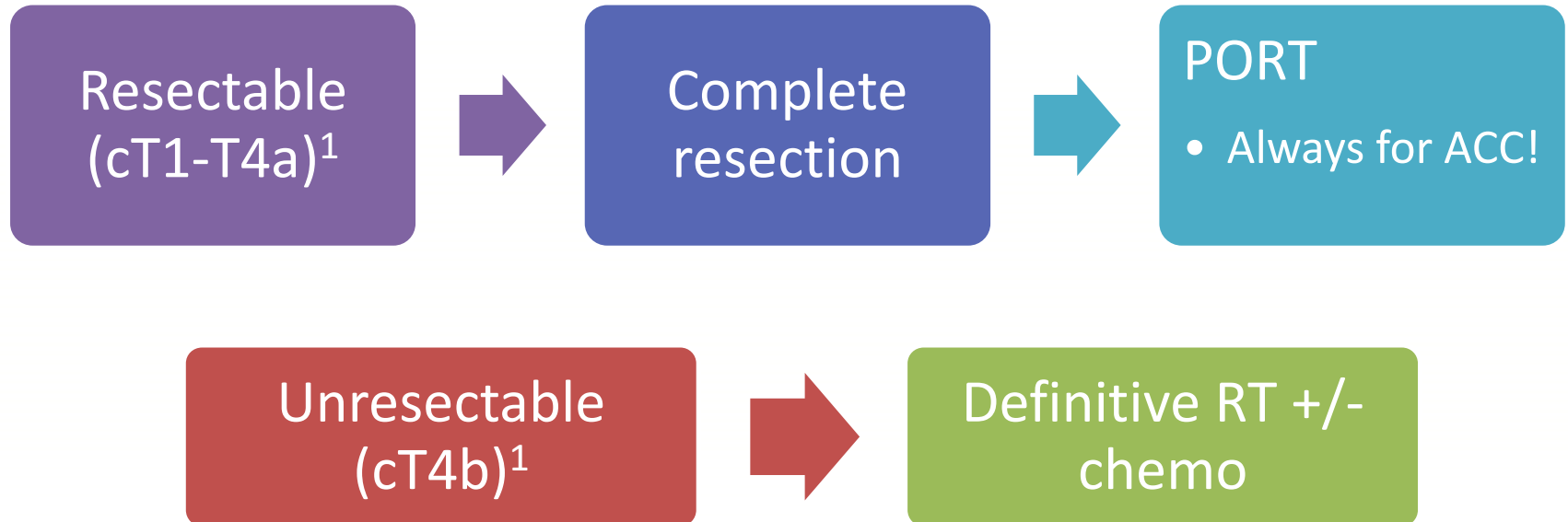
T Category
<b>T1:</b> ≤ 2cm, no EPE
<b>T2:</b> >2cm, ≤ 4cm, no EPE
<b>T3:</b> >4cm and/or EPE(+)
<b>T4a:</b> invades skin, mandible, ear canal, and/or facial nerve <b>T4b:</b> invades skull base and/or pterygoid plates, and/or encases carotid artery

cN Category	pN Category
<b>c/pN1:</b> single ipsi node, ≤ 3cm, no ENE	
<b>cN2a:</b> single ipsi node, >3cm, ≤ 6cm, no ENE <b>cN2b:</b> multiple ipsi nodes, ≤ 6cm, no ENE <b>cN2c:</b> b/l or c/l nodes, ≤ 6cm, no ENE	← Same with the following addition for <b>pN2a:</b> ipsi or c/l single node, ≤ 3cm, and ENE(+)
<b>cN3a:</b> any node >6cm, no ENE <b>cN3b:</b> any node with clinically overt ENE(+)	<b>pN3a:</b> same <b>N3b:</b> single ipsilateral node >3cm with ENE(+) or multiple ipsi, c/l, or b/l nodes any with ENE (+)

Key Terms
<b>EPE:</b> extraparenchymal extension (clinical or macroscopic only)
<b>Ipsi:</b> ipsilateral
<b>ENE:</b> extranodal extension (any)
<b>c/l:</b> contralateral
<b>b/l:</b> bilateral

M Category
<b>M1:</b> any distant mets

# General Management Overview\*



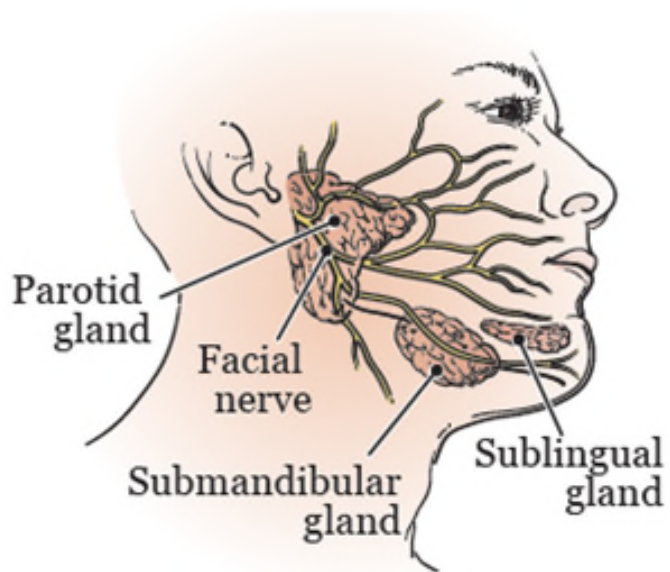
<sup>1</sup>Listed T stages only serve as a guide and do not represent all resectable or unresectable. Some very advanced cases may still be resectable and some less advanced ones may not be (or patient is not medically operable).

\* Acceptable strategy per...

**Management of Salivary Gland Malignancy:  
ASCO Guideline** Geiger, JCO 2021

**NCCN Guidelines Version 3.2021  
Salivary Gland Tumors**

# Surgical Management



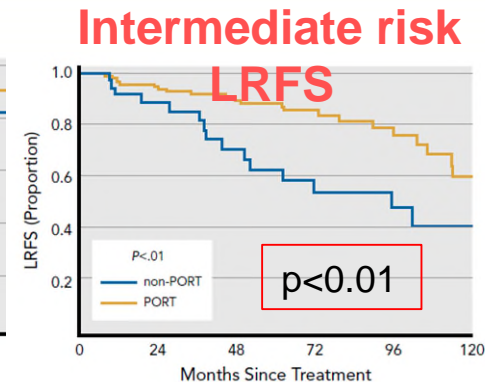
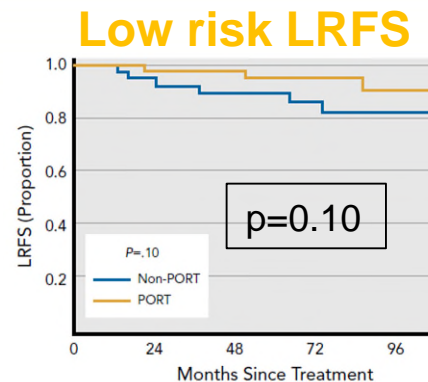
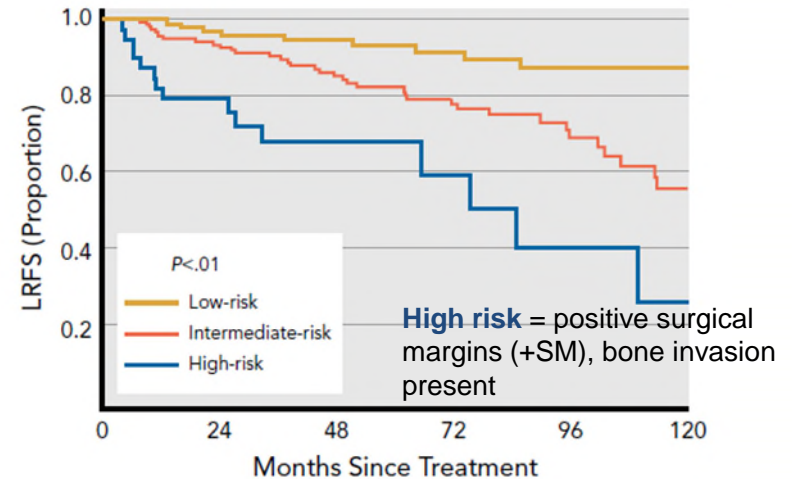
<https://www.mskcc.org/cancer-care/patient-education/salivary-gland-surgery>

**Management of Salivary Gland Malignancy:  
ASCO Guideline** Geiger, JCO 2021

- Radical resection to achieve negative margins is primary treatment
  - Definitive RT associated with worse locoregional control and survival
  - Close/involved margins associated with inferior LRC
- For cN+ neck, perform ipsi neck dissection of involved and at risk stations, up to levels I-V
- Facial nerve preservation (parotid)
  - If no CN7 deficit and dissection plane can be maintained between tumor and nerve → preserve
  - Impaired CN7 preop or if nerve branches encased or grossly involved → resect involved nerves

# Role of Postoperative RT

- Multiple studies indicate that PORT improves LRC
  - However, there are no randomized, prospective trials addressing +/- PORT
  - It is not certain if all patients would benefit
- Chen et al. (JNCCN, 2020) retrospectively reviewed 319 patients with non-metastatic ACC of the head and neck to evaluate role of PORT
  - PORT was identified as a prognostic factor for LRFS on UVA and MVA
    - Greater improvement in LRFS among pts in intermediate/high risk groups
- RT should start within 6-8 weeks of surgery



Low risk = negative surgical margins (-SM), T1-2, primary site in minor/major salivary gland

Int risk = (-SM, T1-2, primary site non-salivary gland), or (-SM, T3-4), or (+SM, no bone invasion)

# RT: Target Volumes and Prescription

NCCN Guidelines Version 3.2021  
Salivary Gland Tumors

PRINCIPLES OF RADIATION THERAPY

## Postoperative RT

**PTV HR:** 60-66 Gy @ 2Gy/fx  
daily

**PTV SR/PTV IR:** 44-50 Gy @  
2Gy/fx to 54-63 Gy @ (1.6-1.8  
Gy/fx) daily

## Definitive RT (or gross disease)

**PTV HR:** 66 @ 2 Gy/fx to 70-  
70.2 @ 1.8-2Gy/fx daily

**PTV SR/PTV IR :** 44-50 Gy @  
2Gy/fx to 54-63 Gy @ (1.6-1.8  
Gy/fx) daily

- **Photon, electrons, protons, or neutrons**
- **PTV HR** includes tumor bed and/or gross disease
  - Boost > 60 Gy for adverse features, such as gross disease, positive margins, ENE
- Always cover associated nerves to at least **skull base** in **int** or **low risk** volume
  - Include gross PNI in **high risk** volume

**For more details about management of PNI:** See ARROCase “Head and Neck Cancers with Perineural Invasion” and the following Critical Review for more details:

Critical Review

IJROBP, 2018  
**Perineural Invasion and Perineural Tumor Spread  
in Head and Neck Cancer**

Richard L. Bakst, MD,<sup>\*</sup> Christine M. Glastonbury, MBBS,<sup>†,‡</sup>  
Upendra Parvathaneni, MBBS, FRANZCR,<sup>§</sup> Nora Katabi, MD,<sup>||</sup>  
Kenneth S. Hu, MD, FASTRO,<sup>¶</sup> and Sue S. Yom, MD, PhD<sup>||</sup>

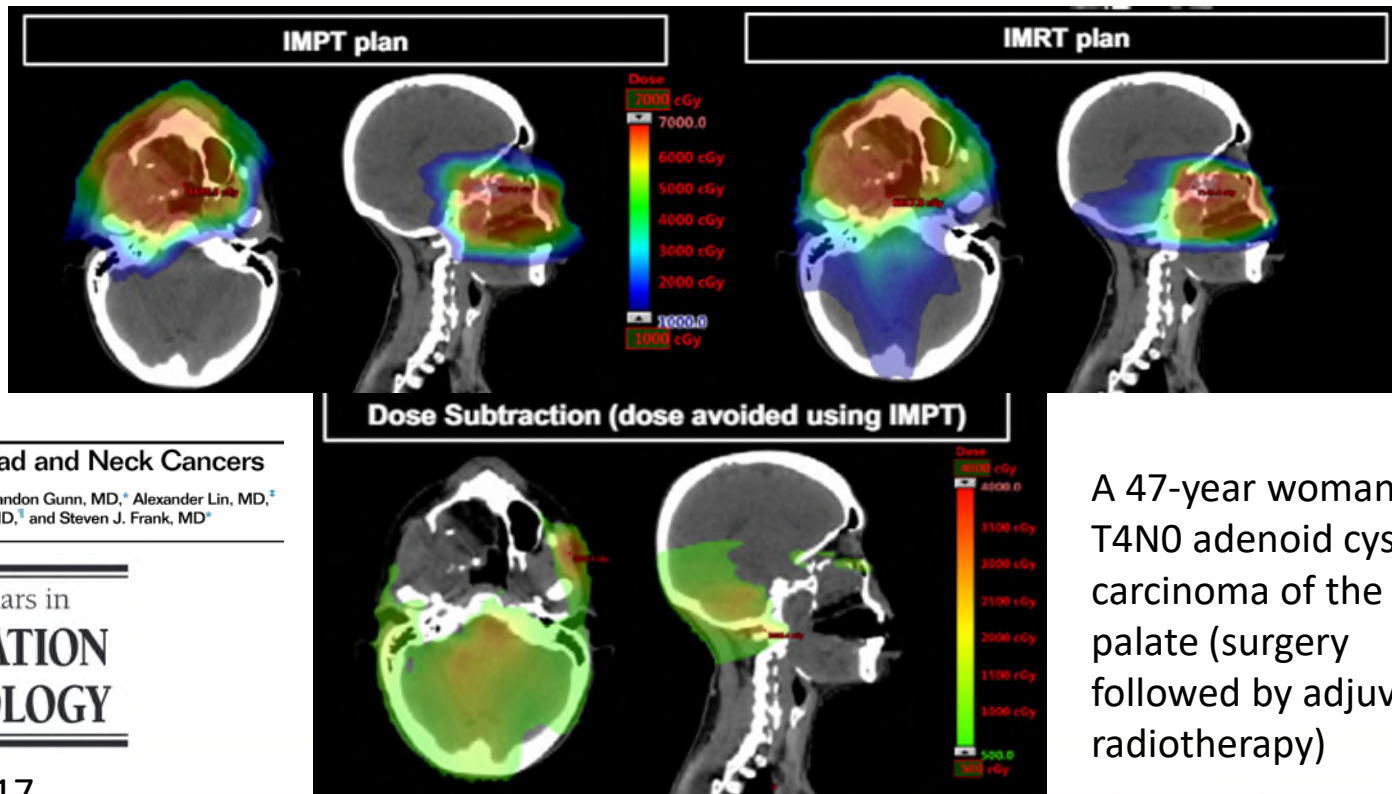


# Proton Therapy

**NCCN Guidelines Version 3.2021  
Salivary Gland Tumors**

## PRINCIPLES OF RADIATION THERAPY

Either IMRT or 3D conformal RT is recommended. Proton therapy can be considered when normal tissue constraints cannot be met by photon-based therapy.



A 47-year woman with T4N0 adenoid cystic carcinoma of the hard palate (surgery followed by adjuvant radiotherapy)

### Proton Therapy for Head and Neck Cancers

Pierre Blanchard, MD, PhD,<sup>1,2</sup> Gary Brandon Gunn, MD,<sup>3</sup> Alexander Lin, MD,<sup>4</sup> Robert L. Foote, MD,<sup>5</sup> Nancy Y. Lee, MD,<sup>3</sup> and Steven J. Frank, MD<sup>6</sup>

Seminars in  
**RADIATION  
ONCOLOGY**

2017

August 20, 2021

ASSOCIATION OF RESIDENTS IN RADIATION ONCOLOGY



# Neutron Therapy

**NCCN Guidelines Version 3.2021  
Salivary Gland Tumors**

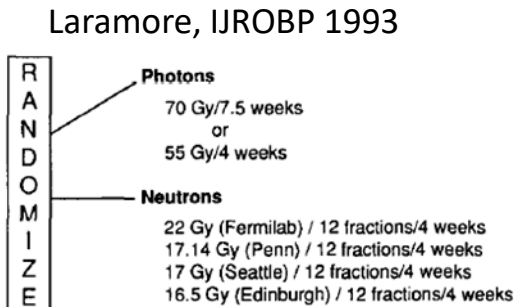
## PRINCIPLES OF RADIATION THERAPY

Neutron therapy was historically considered a promising solution for unresectable salivary gland cancers, but this therapy is currently offered at only one center in the United States. Pfister DG, Spencer S, Brizel DM, et al. NCCN Head and Neck Cancers, Version 1.2015. J Natl Compr Canc Netw 2015;13:847-855.

- Neutron RT may improve LRC compared with photon and/or electron beams because of
  - Lower OER
  - Less repair of sublethal damage (high LET radiation)
  - Less variation of radiosensitivity through the cell cycle
- Cost = higher toxicity

**NEUTRON VERSUS PHOTON IRRADIATION FOR UNRESECTABLE SALIVARY GLAND TUMORS: FINAL REPORT OF AN RTOG-MRC RANDOMIZED CLINICAL TRIAL**

inoperable, unresectable, or recurrent salivary gland carcinoma



### Rate of Local Failure

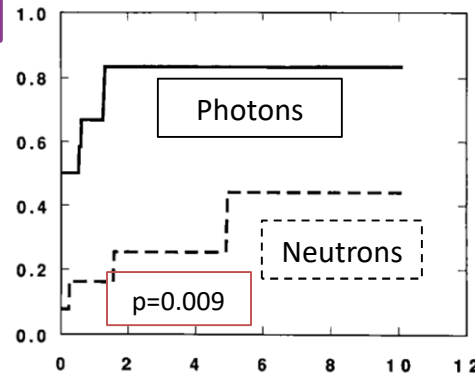


Table 1. Treatment related complications graded "severe or greater" according to the joint RTOG/EOTRC scoring schema

	Photons	Neutrons
Hoarseness	0	1
Dysphagia	1	2
Dehydration	1	2
Malnutrition	1	2
Pain	0	3
Mucosal	1	3
Skin	2	2
Fibrosis	1	2
Necrosis	0	3
Xerostomia	2	1
Impaired taste	1	4
Other	0	1

Note: Some patients exhibited more than one type of complication. There were no fatal complications on either treatment arm.

# Elective Neck Management

- Elective neck dissection or irradiation is generally not indicated due to low rate of LN mets
- Special cases where elective neck management may be indicated:
  - Oral cavity or naso/oropharyngeal primary
  - Clinically suspicious nodes
  - LVSI (+)

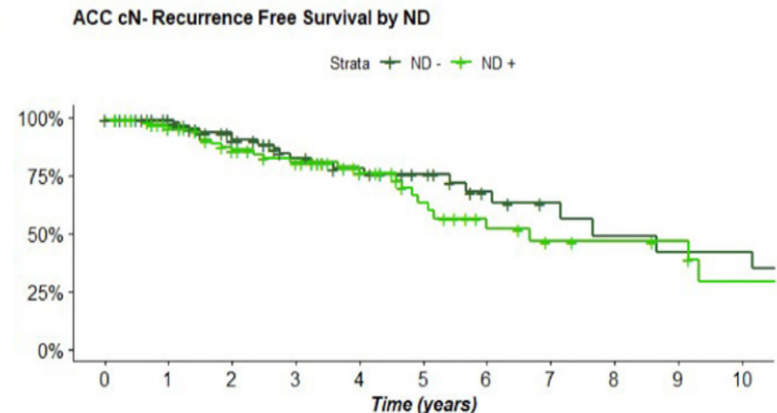
## For END:

Elective neck dissection in adenoid cystic carcinoma of head and neck: yes or no? A systematic review

Luksic, Eur Archives Oto-Rhino-Laryngo 2019

## Against END:

Should a neck dissection be performed on patients with cN0 adenoid cystic carcinoma? A REFCOR propensity score matching study Atallah, Eur J Ca 2020



**In general, ENI is *not* recommended**

# Chemotherapy Remains Investigational

- Role of chemotherapy is not well-defined
  - In neither definitive nor adjuvant settings
- In palliative setting, systemic therapy is typically reserved for symptomatic patients or those with rapid progression
  - Need to weigh risks/benefits of toxicity and unknown impact on disease course, especially given indolent nature
- Concurrent chemotherapy in the primary RT setting for gross disease is our institutional preference

## Results of Phase II Trials (recurrent/metastatic ACC)

Drug	Target	Response Rate
Apatinib	VEGF	30/65 (46.5%) with PR, no CR
Lenvatinib	TK	5/32 (15.6%) with PR, no CR
Sorafenib	VEGF	2/19 (11%) with PR, no CR
Pembrolizumab	PD-1	0/19 with PR/CR outside irradiated areas

Review

Systemic therapy in the management of metastatic or locally recurrent adenoid cystic carcinoma of the salivary glands: a systematic review

See review by Laurie et al., Lancet Oncology 2011 for more

# Future Directions: Concurrent ChemoRT?

Recruitment Status ⓘ : Active, not recruiting

First Posted ⓘ : October 14, 2010

Estimated Study Completion Date ⓘ : October 2028

## RTOG-1008

- Randomized phase II/III trial

Resected malignant tumor of major or minor salivary gland in head/neck

- only high grade (>30% solid component) ACC eligible
- pT3-4 or N+ or pT1-2 N0 with close ( $\leq$  1mm) or microscopically positive margin
- No gross disease
- cM0

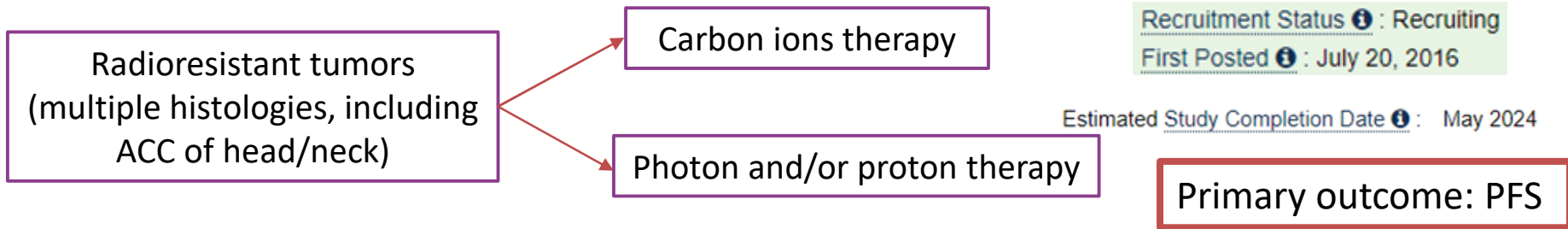
Adjuvant RT alone, 60-66 Gy @ 2Gy/fx  
(IMRT or 3DCRT photons)

Adjuvant RT, 60-66 Gy @ 2Gy/fx +  
weekly cisplatin (40mg/m<sup>2</sup>) x 7 doses

Primary outcome: PFS

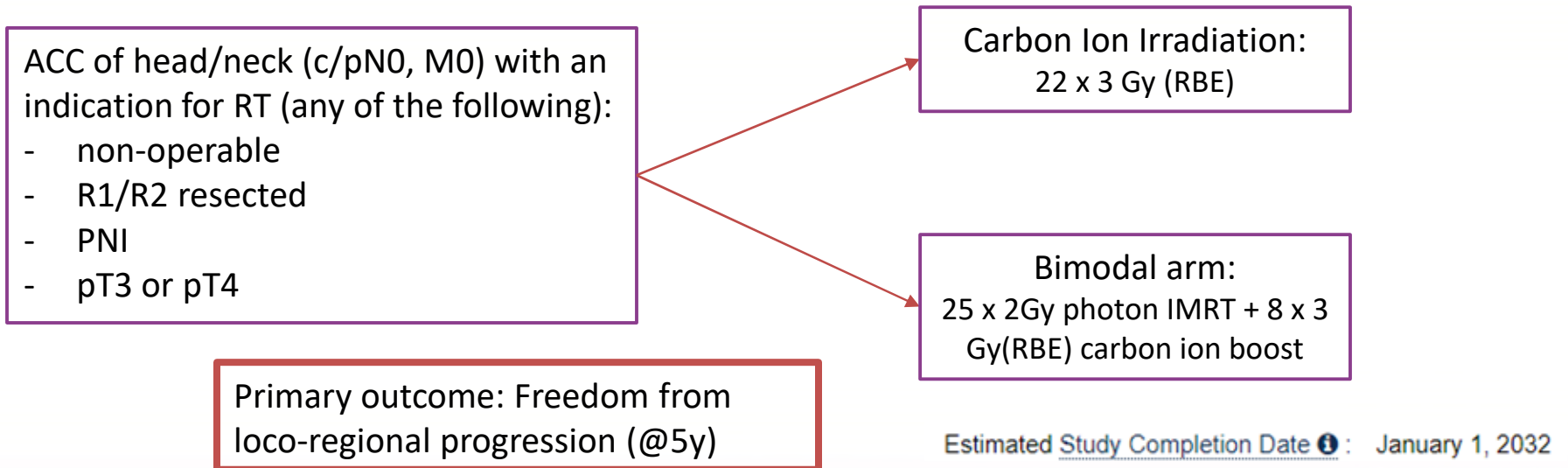
# Future Directions: Carbon Ions?

## ETOILE: Randomized Carbon Ions vs Standard RT for Radioresistant Tumors



## ACCO: Adenoid Cystic Carcinoma and Carbon Only Irradiation

- Randomized prospective trial



# Conclusions

- Adenoid cystic carcinoma of the head and neck is a rare malignancy with an indolent course but tendency for PNI and disease recurrence (often distant mets)
- Surgical resection is the main treatment, typically followed by adjuvant radiotherapy, which improves locoregional control
  - Definitive RT is recommended when patient is not an operative candidate, surgery is too morbid, or GTR unlikely
- Particle therapy may offer improved tumor control and lower doses to OARs but currently photons/electrons are SOC
- Elective neck irradiation is generally not recommended
- The role of systemic therapy is still under investigation

# References

- Geiger JL, Ismaila N, Beadle B, et al. Management of salivary gland malignancy: ASCO guideline. *Journal of Clinical Oncology* 2021;39(17):1909–41.
- National Comprehensive Cancer Network. Head and neck cancers: salivary gland tumors. NCCN Guidelines Version 3.2021. [https://www.nccn.org/professionals/physician\\_gls/pdf/head-and-neck.pdf](https://www.nccn.org/professionals/physician_gls/pdf/head-and-neck.pdf) (accessed July 27, 2021).
- NIH: U.S. National Library of Medicine. ClinicalTrials.gov. <https://clinicaltrials.gov/> (accessed July 27, 2021).
- Zhu G, Zhang L, Dou S, et al. Apatinib in patients with recurrent or metastatic adenoid cystic carcinoma of the head and neck: A single-arm, phase II prospective study. *Therapeutic Advances in Medical Oncology* 2021;13:1-11.
- Mahmood U, Bang A, Chen Y-H, et al. A randomized phase 2 study of pembrolizumab with or without radiation in patients with recurrent or metastatic adenoid cystic carcinoma. *International Journal of Radiation Oncology, Biology, Physics* 2021;109(1):134–44.
- ASCO, Cancer.Net Editorial Board. Adenoid cystic Carcinoma. *Cancer.Net*. 2020. <https://www.cancer.net/cancer-types/adenoid-cystic-carcinoma/introduction> (accessed July 27, 2021).
- Atallah S, Moya-Plana A, Malard O, et al. Should a neck dissection be performed on patients with cN0 adenoid cystic carcinoma? A REFCOR propensity score matching study. *European Journal of Cancer* 2020;130:250–8.



# References

- Chen Y, Zheng Z-Q, Chen F-P, et al. Role of postoperative radiotherapy in nonmetastatic head and neck adenoid cystic carcinoma. *Journal of the National Comprehensive Cancer Network* 2020;18(11):1476–84.
- Bakst RL, Glastonbury CM, Parvathaneni U, Katabi N, Hu KS, Yom SS. Perineural invasion and Perineural Tumor spread in head and neck cancer. *International Journal of Radiation Oncology, Biology, Physics* 2019;103(5):1109–24.
- Luksic I, Suton P. Elective neck dissection in adenoid cystic carcinoma of head and neck: Yes or no? A systematic review. *European Archives of Oto-Rhino-Laryngology* 2019;276(11):2957–62.
- Tchekmedyian V, Sherman EJ, Dunn L, et al. Phase II study of lenvatinib in patients with progressive, recurrent or metastatic adenoid cystic carcinoma. *Journal of Clinical Oncology* 2019;37(18):1529–37.
- Amin MB, Lydiatt WM, Shah JP, O'Sullivan B, Patel SG. Staging Head and Neck Cancers. *AJCC cancer staging manual: Eight Edition*. New York, NY: Springer; 2017. p. 55–181.
- Blanchard P, Gunn GB, Lin A, et al. Proton therapy for head and neck cancers. *Seminars in Radiation Oncology* 2017;28(1): 53-63.
- Thomson DJ, Silva P, Denton K, et al. Phase II trial of sorafenib in advanced salivary adenoid cystic carcinoma of the head and neck. *Head & Neck* 2014;37(2):182–7.
- Balamucki CJ, Amdur RJ, Werning JW, et al. Adenoid cystic carcinoma of the head and neck. *American Journal of Otolaryngology* 2012;33: 510-518.
- Laurie SA, Ho AL, Fury MG, Sherman E, Pfister DG. Systemic therapy in the management of metastatic or locally recurrent adenoid cystic carcinoma of the salivary glands: A systematic review. *The Lancet Oncology* 2011;12(8):815–24.

# References

- Yeung TH, Wong CS, Chu YC, et al. Prolonged survival with multiple pulmonary metastases from adenoid cystic carcinoma after conservative management. Hong Kong Journal of Radiology. 2009;12: 68-71.
- Thariat J, Fournier LS, Badoual C, Marcy P-Y, Housset M. Aggressive adenoid cystic carcinoma with asymptomatic spinal cord compression revealed by a “curtain sign.” Journal of Radiology Case Reports 2008;2(1).
- Gomez DR, Hoppe BS, Wolden SL, et al. Outcomes and prognostic variables in adenoid cystic carcinoma of the head and neck: a recent experience. International Journal of Radiation Oncology, Biology, Physics 2008;70(5):1365–72.
- Laramore GE, Krall JM, Griffin TW, et al. Neutron versus photon irradiation for unresectable salivary gland tumors: Final report of an RTOG-MRC randomized clinical trial. International Journal of Radiation Oncology, Biology, Physics 1993;27(2):235–40.
- Szanto PA, Luna MA, Tortoledo ME, White RA. Histologic grading of adenoid cystic carcinoma of the salivary glands. Cancer 1984;54(6):1062–9.
- Spiro RH, Huvos AG, Strong EW. Adenoid cystic carcinoma of salivary origin. The American Journal of Surgery 1974;128(4):512–20.

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