

# Superior Sulcus Tumors (Pancoast Tumors)

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# Introduction

- Definition
  - Malignancy – non-small cell lung cancer (NSCLC)
  - Apex of upper lobe of lung
  - Represent 5% of all NSCLC
  - Chest wall invasion
- Presentation
  - Chest or arm pain
  - Motor dysfunction in ulnar nerve distribution
  - Horner's syndrome (ptosis, miosis, anhidrosis)
- May present with locally advanced disease
  - Vertebral column
  - Subclavian artery or vein
  - Brachial plexus



# Diagnosis

## Clinical symptoms

- Chest, shoulder or arm pain
- Paresthesia
- Muscle atrophy in ulnar nerve distribution
- Loss of triceps reflex
- Horner's syndrome
- Less commonly
  - Cough
  - Shortness of breath
  - Hemoptysis



# Staging

- PET imaging
- Brain MRI
- MRI of thoracic inlet
  - subclavian artery / vein involvement
  - Brachial plexus involvement<sup>1</sup>
    - More sensitive than CT for determining vascular or nerve involvement
- Tissue diagnosis
  - Bronchoscope effective in 10-20% of cases<sup>2</sup>
  - CT guided biopsy
- Mediastinal lymph node tissue sampling
  - EBUS
  - mediastinoscopy

<sup>1</sup> Weinreb JC, Clin Chest Med 1991

<sup>2</sup> Narayan S, Nat Clin Pract Oncol 2006



# Patient Selection

- Tumor Resectability
- Cardiac reserve
  - Exercise tolerance  $\geq 4$  METS
  - Medical history
    - Diabetes
    - Renal insufficiency (creatinine  $\geq 2$ )
    - Compensated CHF
    - Prior MI
    - Mild angina

Eagle KA, Circulation 2002

- Pulmonary function
  - Post operative predicted FEV<sub>1</sub> and DLCO  $\geq 40\%$
  - Postoperative pulmonary function nadir is lower than calculated values

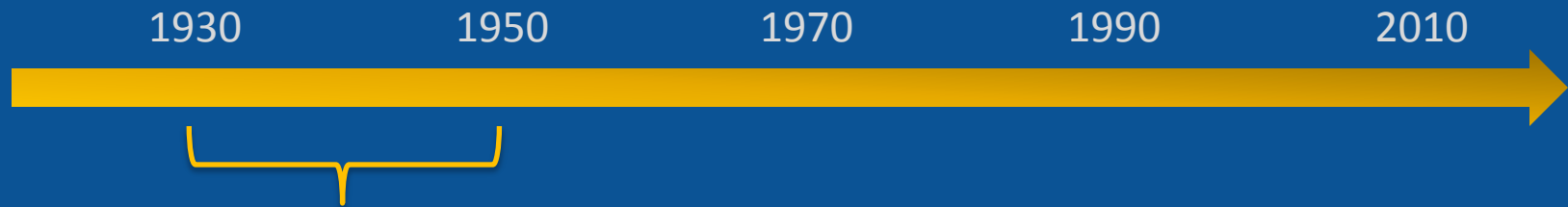


# Historical perspective

- Edwin Hare described a patient presenting with
  - Apical chest mass
  - Shoulder pain
  - Muscle atrophy in the ulnar distribution (1838)
- Henry Pancoast (radiologist) described 7 patients with similar symptoms and small apical chest masses
- Lung opacities initially believed to be infectious or embryonic rests
- Malignant nature of tumor identified in 1923



# Timeline:



- Pancoast tumors considered inoperable
- Radiation was primary treatment
  - 45-70 Gy
  - > 50 Gy associated with higher morbidity and mortality
  - > 50 Gy more efficacious
  - 5-10% 5-year survival rate

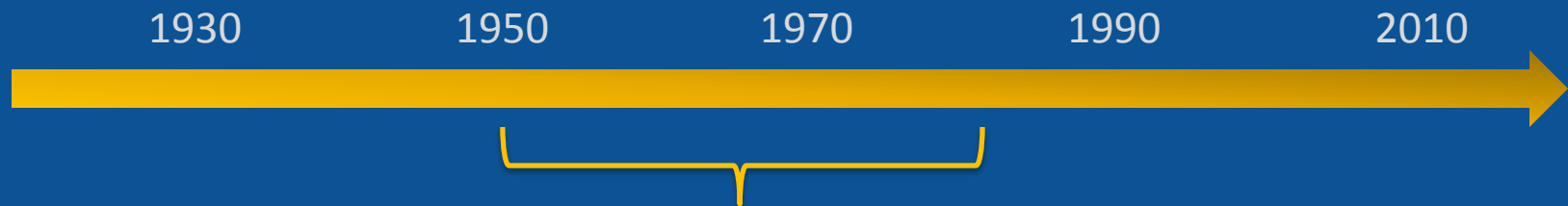
Ashe WM, J Thorac Surg 1951

Attar S, Ann Thorac Surg 1979

Bretz G, Radiology 1970



# Timeline:



- Surgery / Radiation
- Chardack and MacCallum
  - Surgery followed by radiation
- Shaw and Paulson
  - Treated unresectable patients with palliative chemotherapy / radiation
  - Converted unresectable tumor into resectable
- Shaw
  - Neoadjuvant treatment with 30 Gy followed by surgery
  - Preferred treatment plan
  - Patients with spine, vascular or nerve involvement excluded

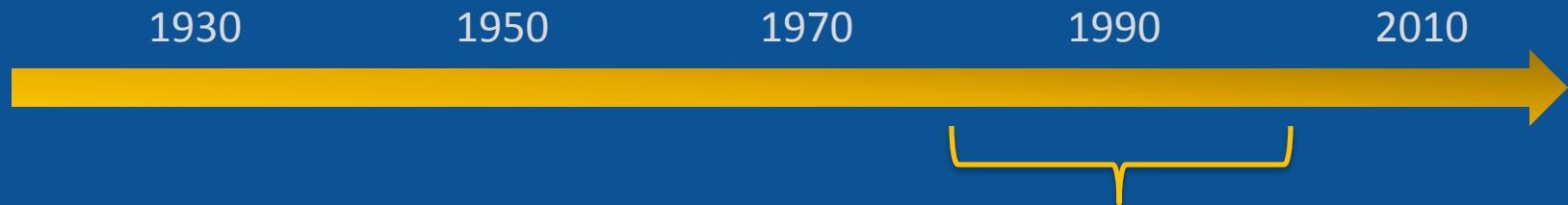
Chardack WM and MacCallum JD, T Thorac Surg 1956

Shaw RR, Ann Surg 1961

Shaw RR, Ann Thorac Surg 1984



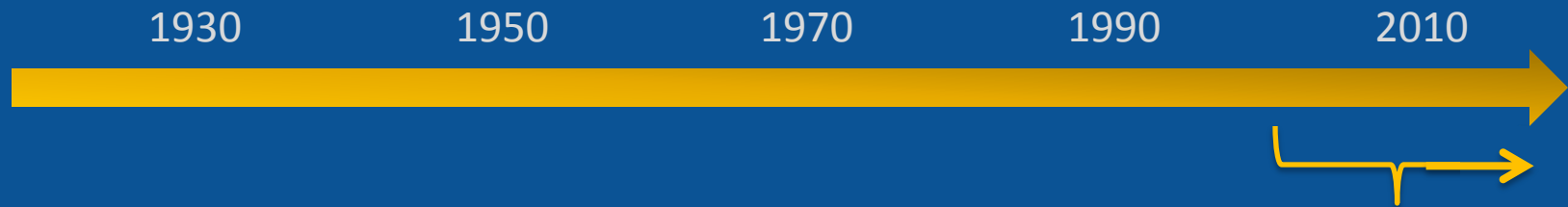
# Timeline:



- Surgery / Radiation
- Extension of patients eligible for this treatment
  - Inclusion of patients with spine or subclavian vessel involvement
  - 5 year survival remained 30%
- No clear consensus regarding preoperative radiation dose
  - 40-60 Gy initially used
  - Reduced to 30 Gy due to perioperative morbidity and mortality



# Timeline:



- Surgery / Radiation / Chemotherapy
  - 3 cycles Cisplatin / etoposide or paclitaxel
  - Concurrent chemoradiotherapy
    - Cisplatin / etoposide
    - 45 Gy
- 56% complete pathological response
- 44% 5-year survival



# Is Surgery Necessary?

- Retrospective review
  - 52 patients with superior sulcus tumors
    - IIB (n=15)      IIIA (n=4)
    - IIIB (n=20)    IV (n=13)
  - Induction therapy
    - Cisplatin 6 mg / m<sup>2</sup> – daily
    - 66 Gy (61-67 Gy)
  - following induction therapy 22 underwent surgery
  - 13 (62%) were pathological complete responders
    - Complete responders have improved survival
    - Hazard ratio of death is 0.5

Kappers I, Eur J Cardiothorac Surg 2009

Pourel N, Eur J Cardiothorac Surg 2008



# Imaging does not predict pCR

## Pathological Response

### Radiographic Response

	Complete Response	Partial Response	Stable Disease	Disease Progression
Complete Response	-	-	-	-
Partial Response	6	2	-	-
Stable Disease	7	2	3	1



# Imaging does not predict pCR

## Pathological Response

### Radiographic Response

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# Imaging does not predict pCR

## Pathological Response

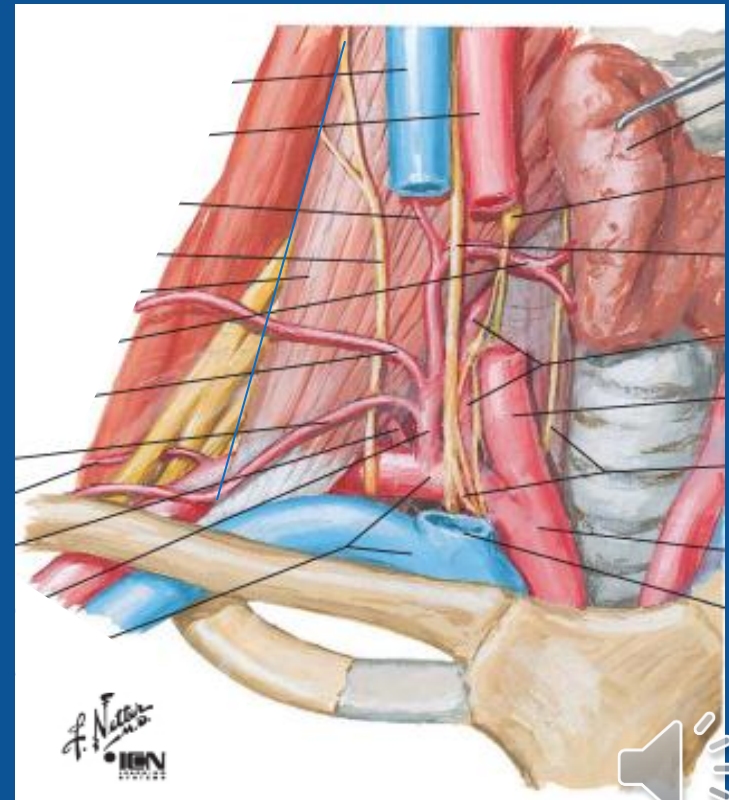
### Radiographic Response

	Complete Response	Partial Response	Stable Disease	Disease Progression
Complete Response	-	-	-	-
Partial Response →	6	2	-	-
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# Anatomy

- Three compartments of thoracic inlet – determined by relationship to anterior and middle scale muscles
  - Anterior (**anterior to anterior scalene**)
    - Platysma
    - Sternocleidomastoid
    - Jugular and subclavian vein
    - omohyoid muscle
    - Scalene fat pad

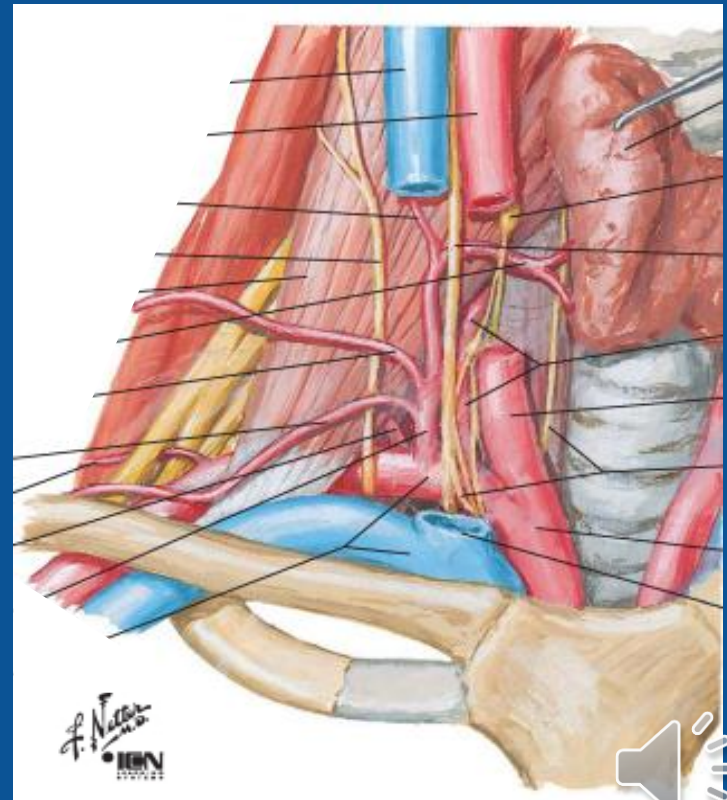


# Anatomy

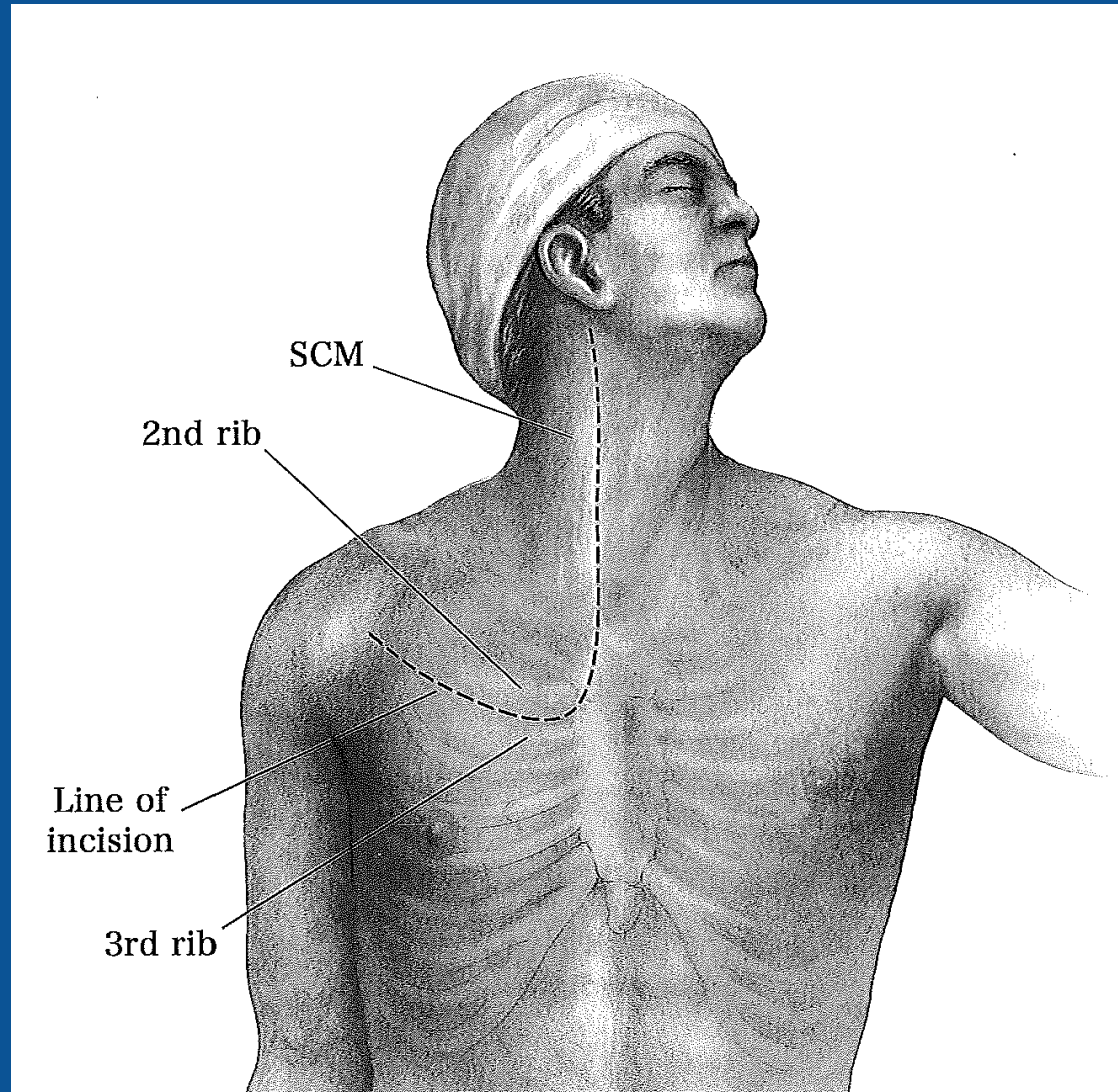
## – Middle

(anterior surface of anterior scalene to posterior surface of middle scalene)

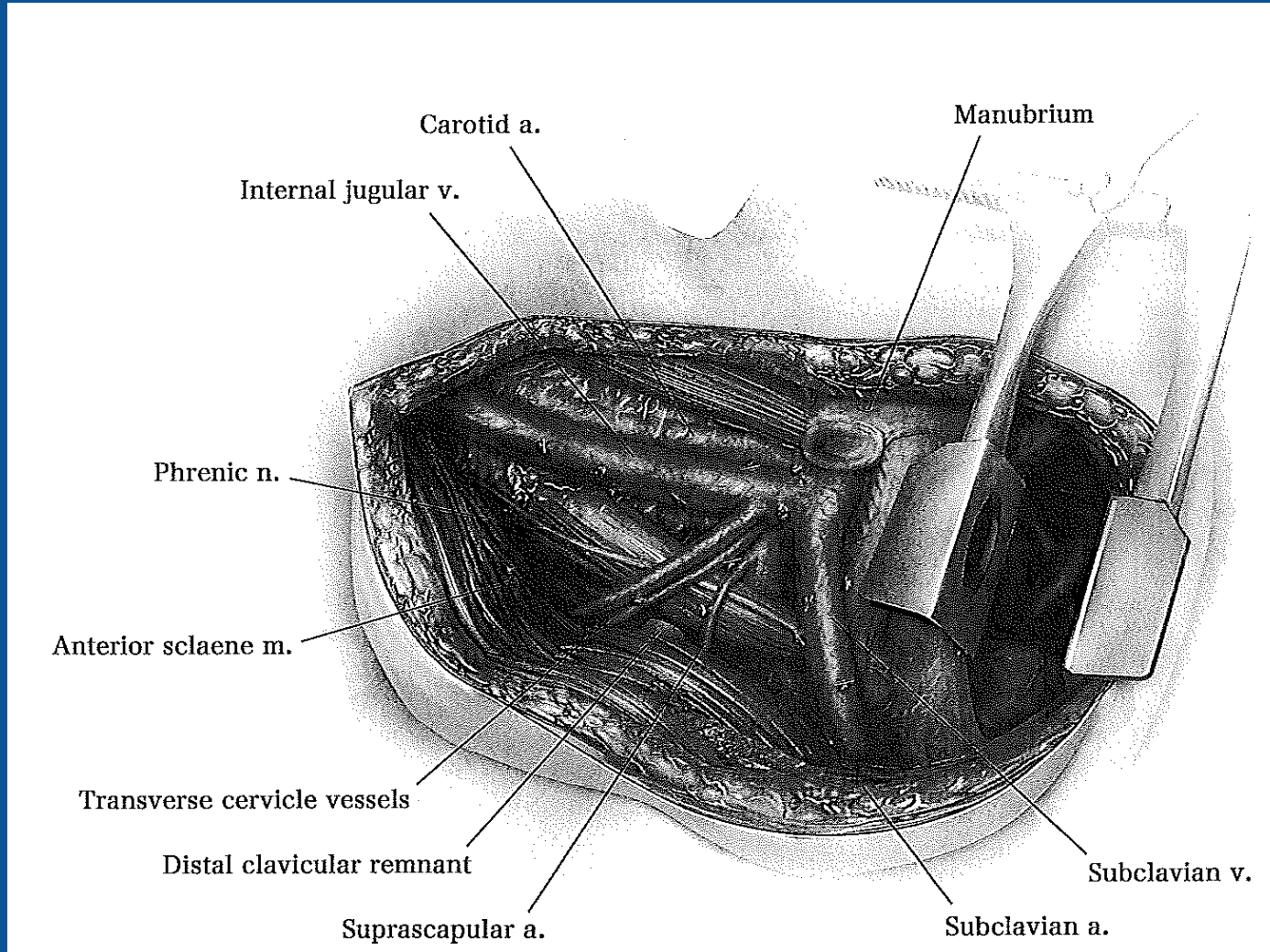
- Anterior and middle scalene muscles
- Phrenic nerve
- Subclavian artery
- Brachial plexus



# Anterior Approach



# Anterior Approach

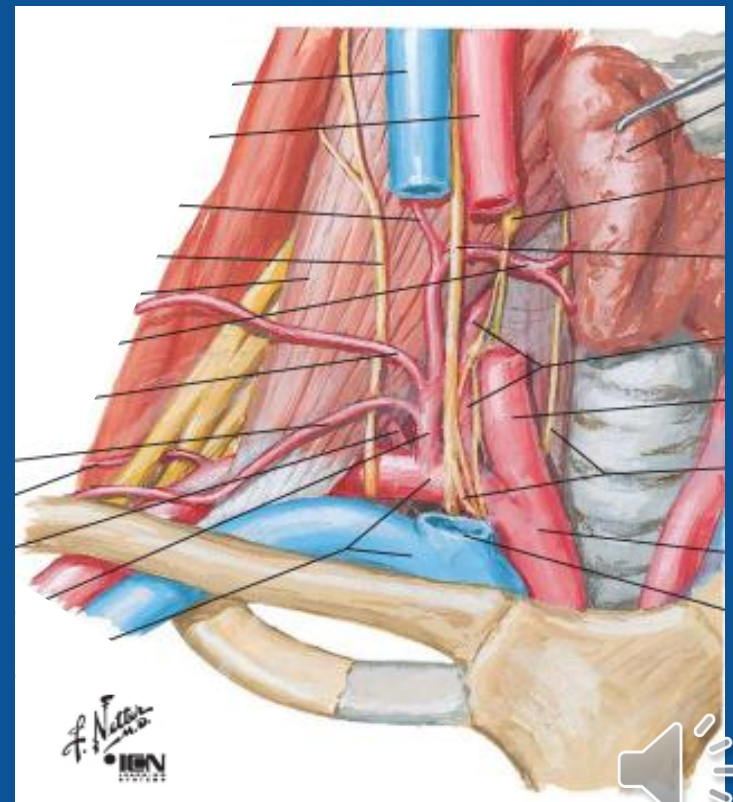


# Anatomy

## – Posterior

(posterior to middle scalene)

- Nerve roots of brachial plexus
- Long thoracic nerve
- Sympathetic nerve chain
- Vertebral bodies



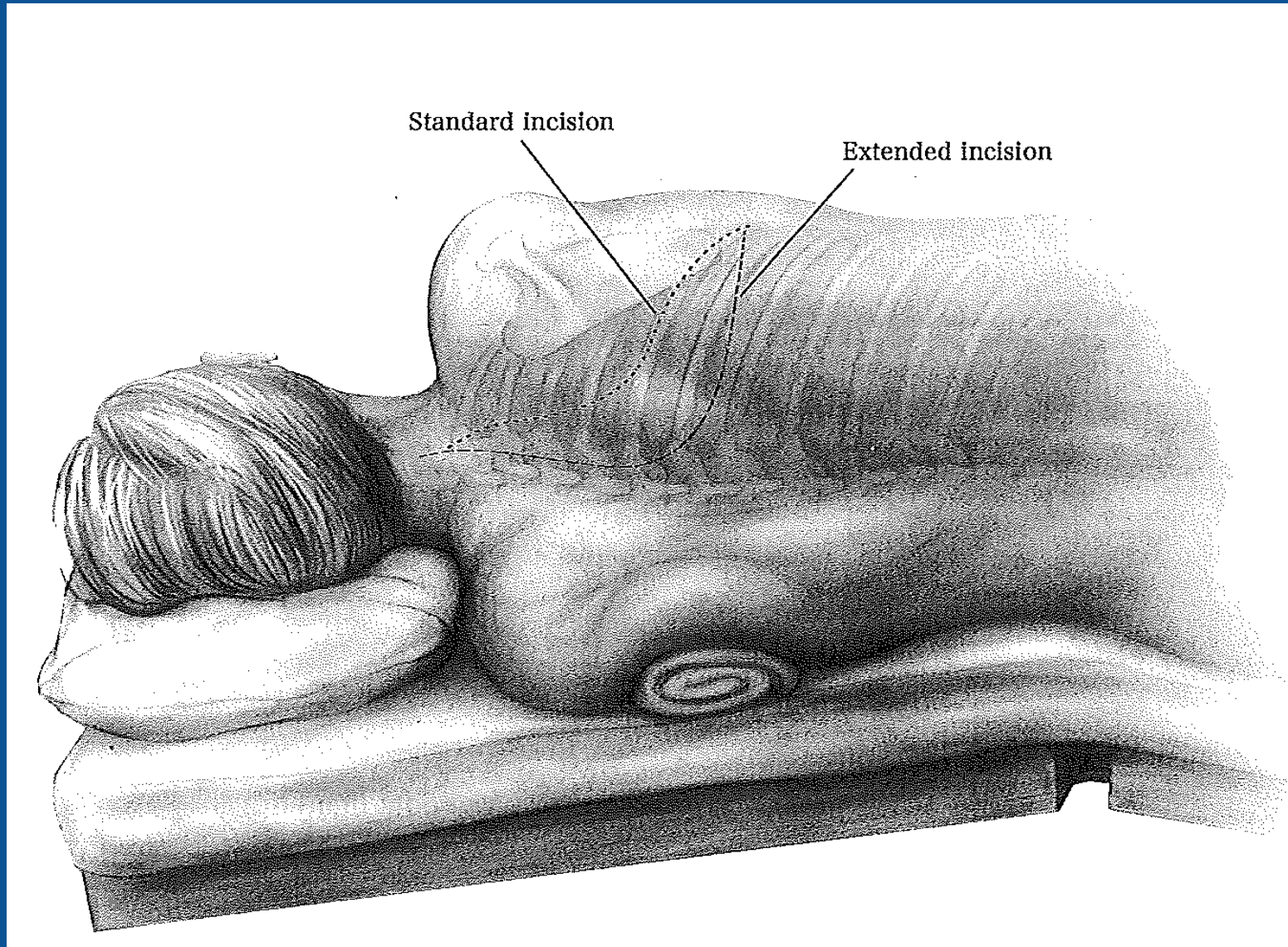
# Imaging



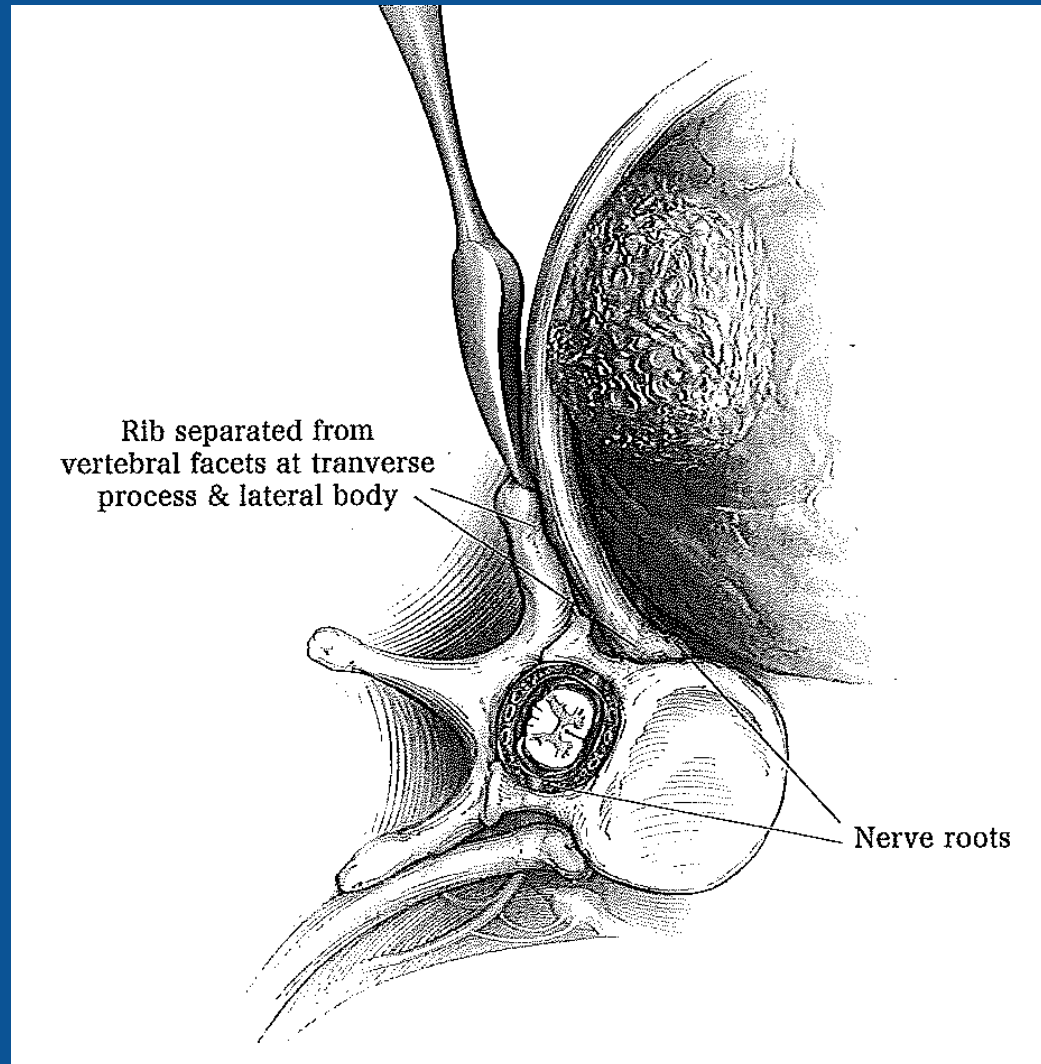
CT



# Posterior Approach



# Posterior Approach



# N2 disease

- N2 disease is an important prognostic factor in NSCLC – including Pancoast tumors<sup>1</sup>
- Anderson identified N2 disease as an important negative prognostic factor<sup>2</sup>
- Many protocols excluded patients with N2 involvement<sup>3</sup>
- Kwong showed no difference in outcomes among patients with Pancoast tumors with positive N2 nodes<sup>4</sup>
- No randomized study comparing chemo / radiation to chemo / radiation / surgery for patients with Pancoast tumors and N2 involvement

<sup>1</sup>Hilaris BS, Surg Clin N Am 1987

<sup>2</sup> Anderson TM, J Clin Oncol 1986

<sup>3</sup> Rush VW, J Clin Oncol 2007

<sup>4</sup> Kwong KF, J Thorac Cardiovasc Surg 2005



# Supraclavicular lymph nodes

- Prognosis may be better among patients with supraclavicular (N3) lymph nodes compared to mediastinal (N2) lymph nodes
  - 14% 5-year survival with supraclavicular nodes
  - 0% 5-year survival with mediastinal nodes

Ginsberg RJ, Ann Thorac Surg 1994

- Involvement of supraclavicular nodes does not preclude resection

Detterbeck FC, Ann Thorac Surg 2003



# Brachial plexus involvement

- Nerve involvement
  - T1 nerve root resection – intrinsic hand muscle weakness
  - C8 nerve root resection – paralysis of hand muscles
  - Nerve involvement can be assessed with MRI and physical examination
    - Forearm pain is consistent with T1 involvement
    - Hand pain is consistent with C8 involvement



# Vertebral body involvement

- Historically vertebral body involvement was associated with poor

Ginsberg RJ, Ann Thorac Surg 1994

Wright CD, J Thorac Cardiovasc Surg 1987

Chiles C, Radiographics 1999

- More recently, acceptable survival rates have been achieved with vertebral involvement

– Survival improved with R<sub>0</sub> resection

Bilsky MH, J Neurosurg 2002



# Summary

- Pancoast tumors represent a small minority of non-small cell lung cancers
- Historically, resection of these tumors was associated with high rates of incomplete resection
- Neoadjuvant chemotherapy and radiation followed by surgery is now the standard of care and is associated with acceptable 5-year survival rates

