Debunking Myths: Is More Resection Always Better in Stage I Lung Cancer?

An overview of sub-lobar resections

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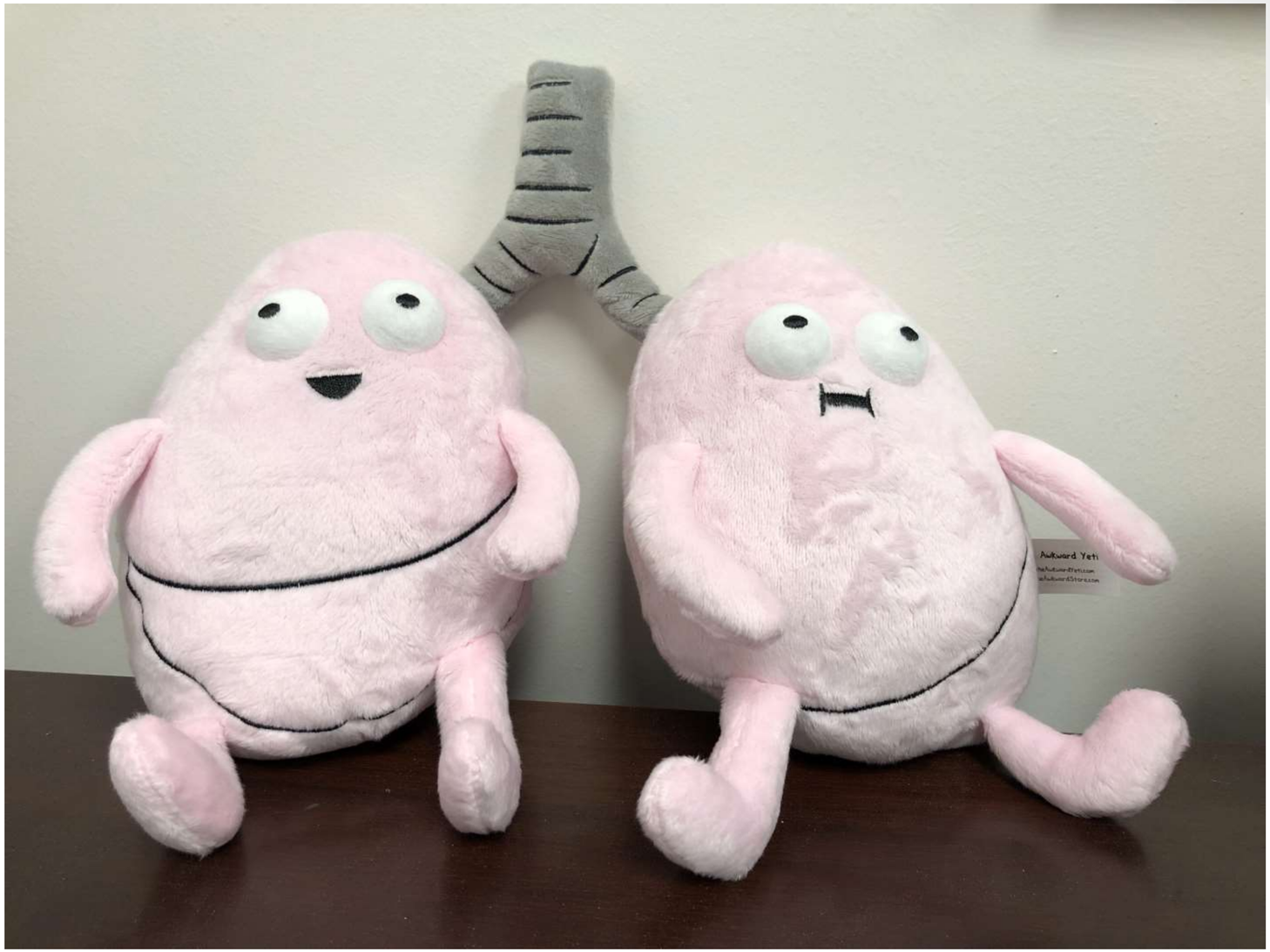
No Disclosures



Objectives

1. To compare the clinical effectiveness of lobectomy and sub-lobar resection for Stage I lung cancer patients.

2. To evaluate the impact of lobectomy and sub-lobar resection on patient quality of life and postoperative recovery.

3. To recommend a patient-centered approach for choosing between lobectomy and wedge resection in Stage I lung cancer.

Lung Cancer

Second most common cancer in men and women

The leading cause of cancer death in men and women

- More die from lung cancer than colon, breast, and prostate cancer combined
- 1 in 5 cancer deaths

Risk of having lung cancer in your lifetime

- 1 in 16 men
- 1 in 17 women

There are an estimated 125,070 deaths from lung cancer for 2024

https://www.cancer.org/cancer/lung-cancer/about/key-statistics.html

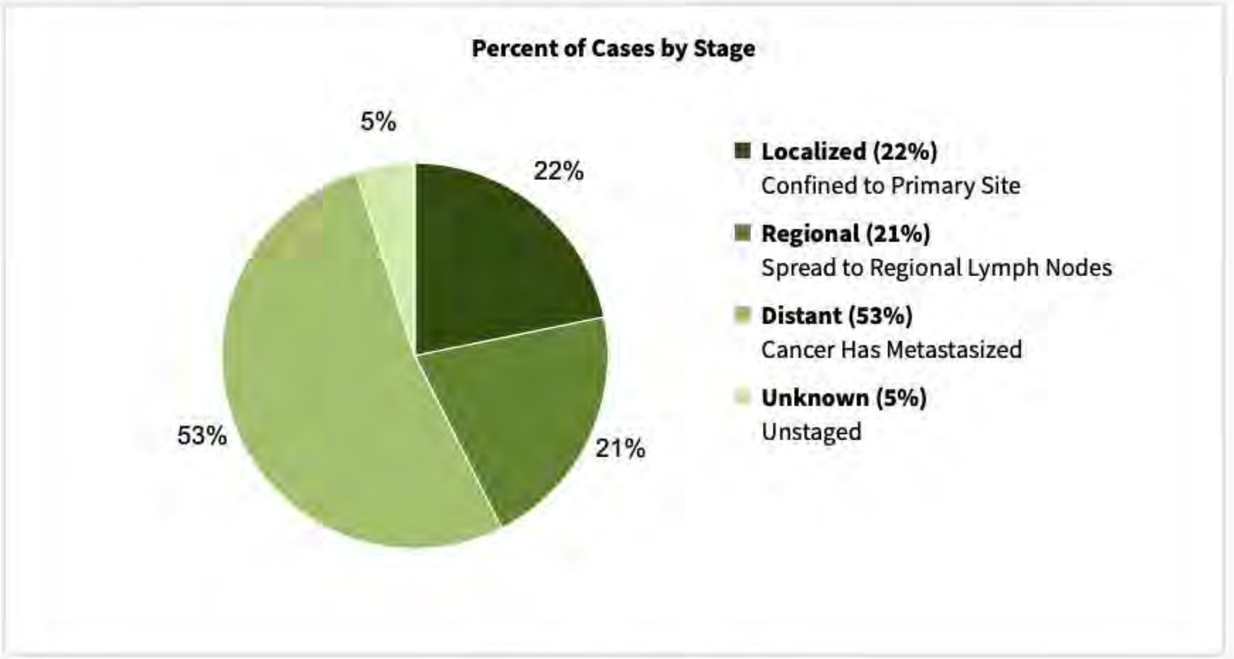
Lung Cancer

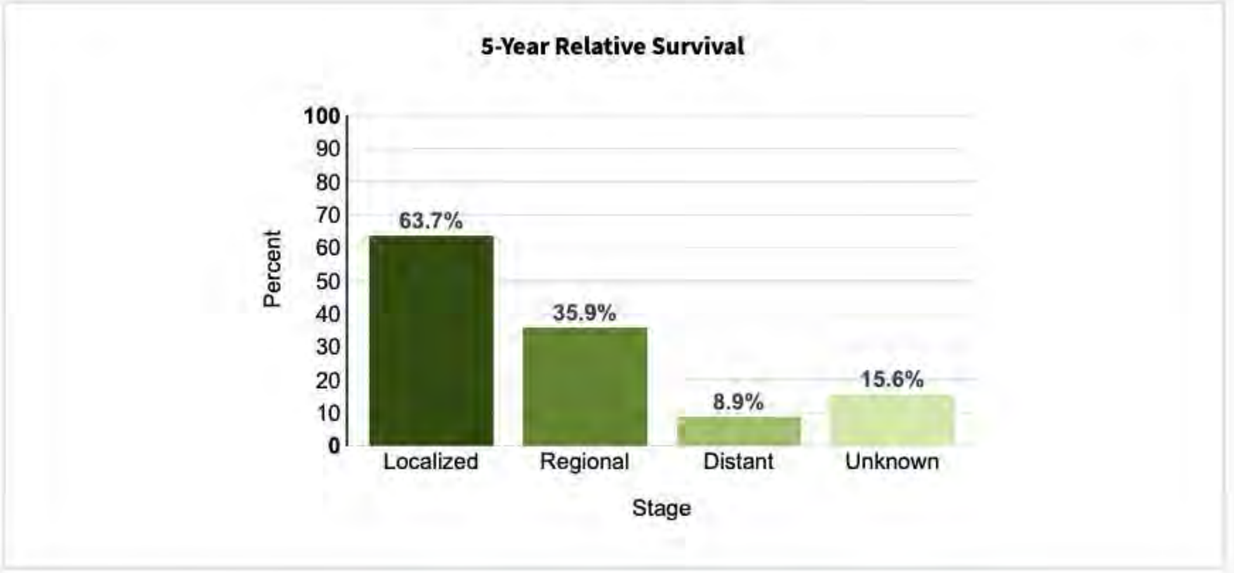
There are an estimated 234,580 new cases of lung cancer in the U.S. for 2024 (116,310 men 118,270 women)

There are an estimated 125,070 deaths from lung cancer in the U.S. for 2024 (65,790 men 59,280 women)

https://www.cancer.org/cancer/lung-cancer/about/key-statistics.html

Percent of Cases & 5-Year Relative Survival by Stage at Diagnosis: Lung and Bronchus Cancer





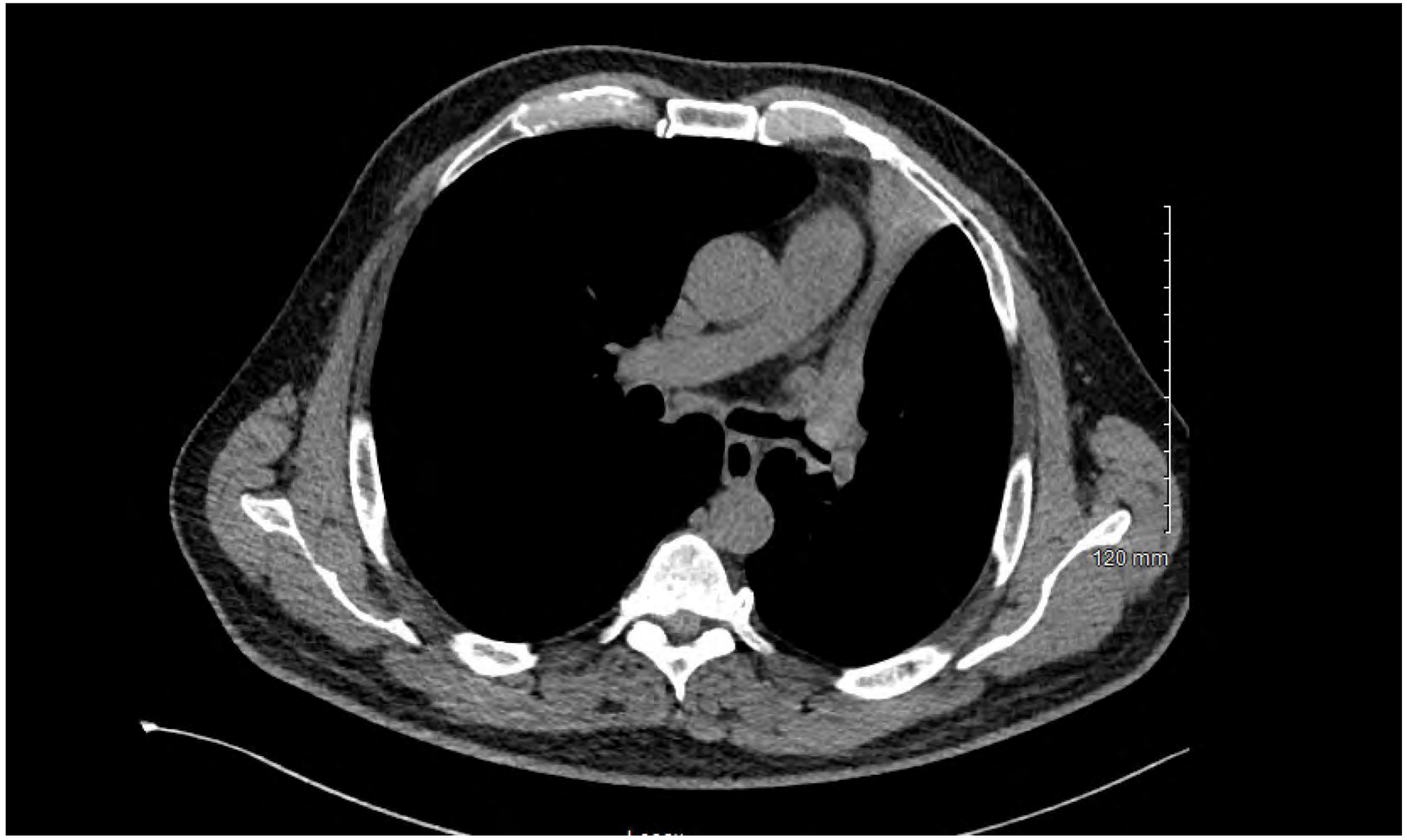
SEER 22 (Excluding IL/MA) 2014–2020, All Races, Both Sexes by SEER Combined Summary Stage

https://seer.cancer.gov/statfacts/html/lungb.html

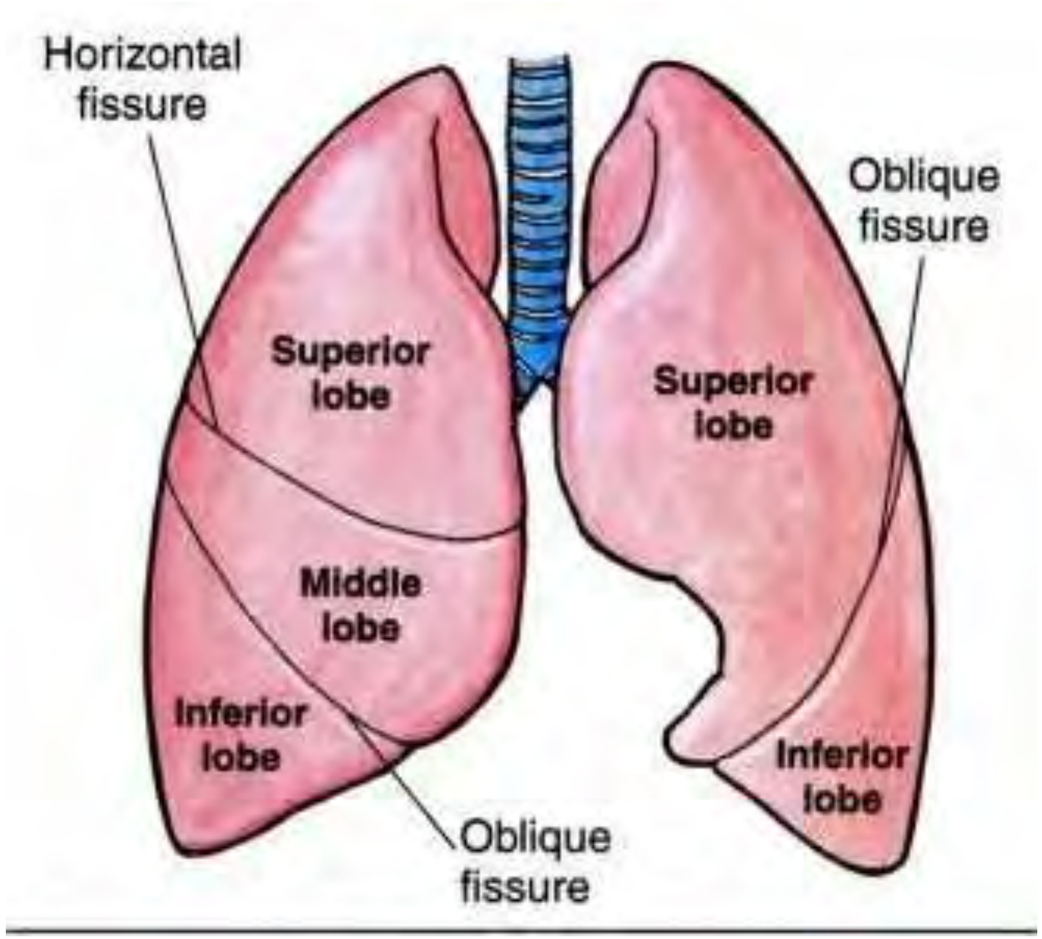
Options for Resection

Pneumonectomy

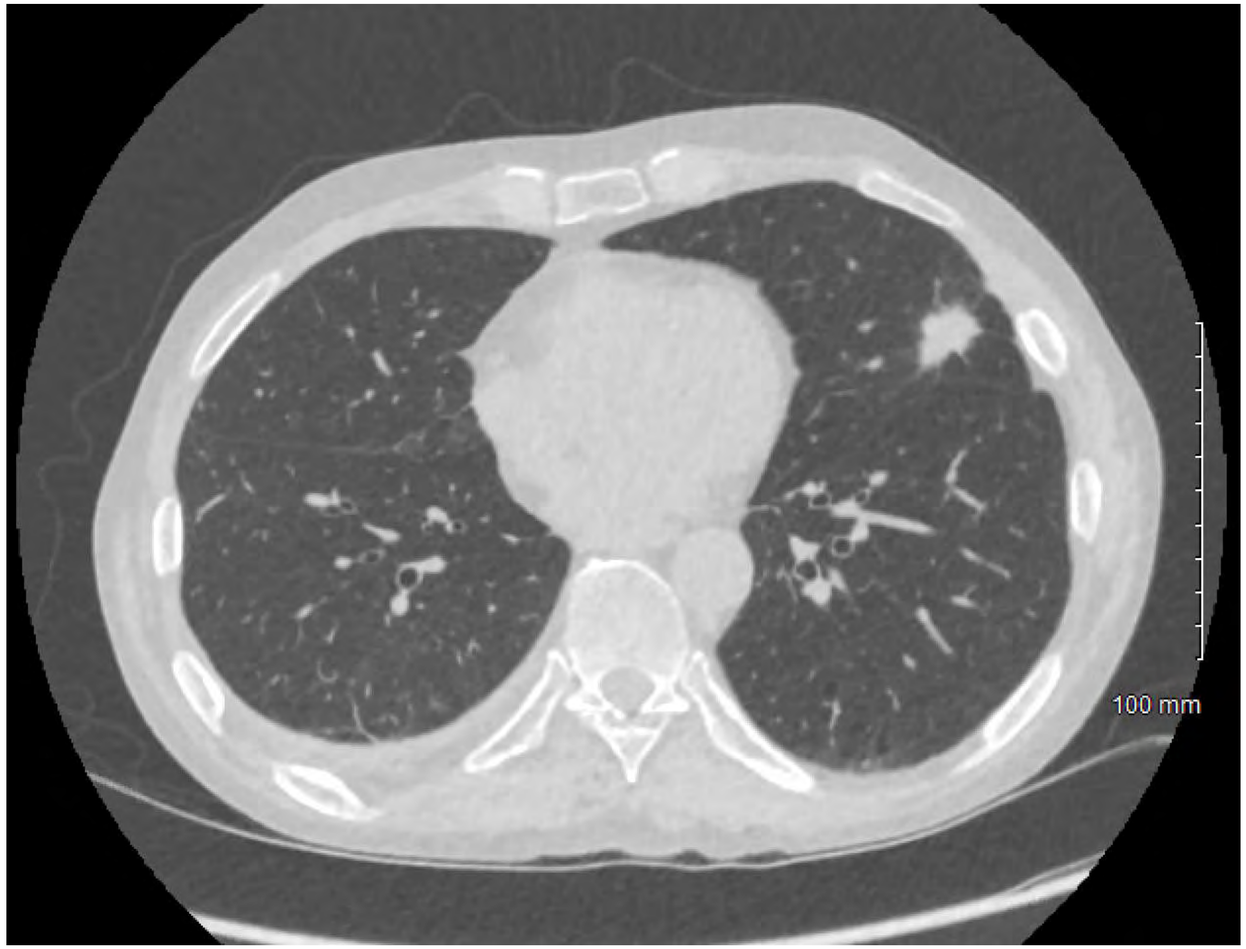
Pneumonectomy



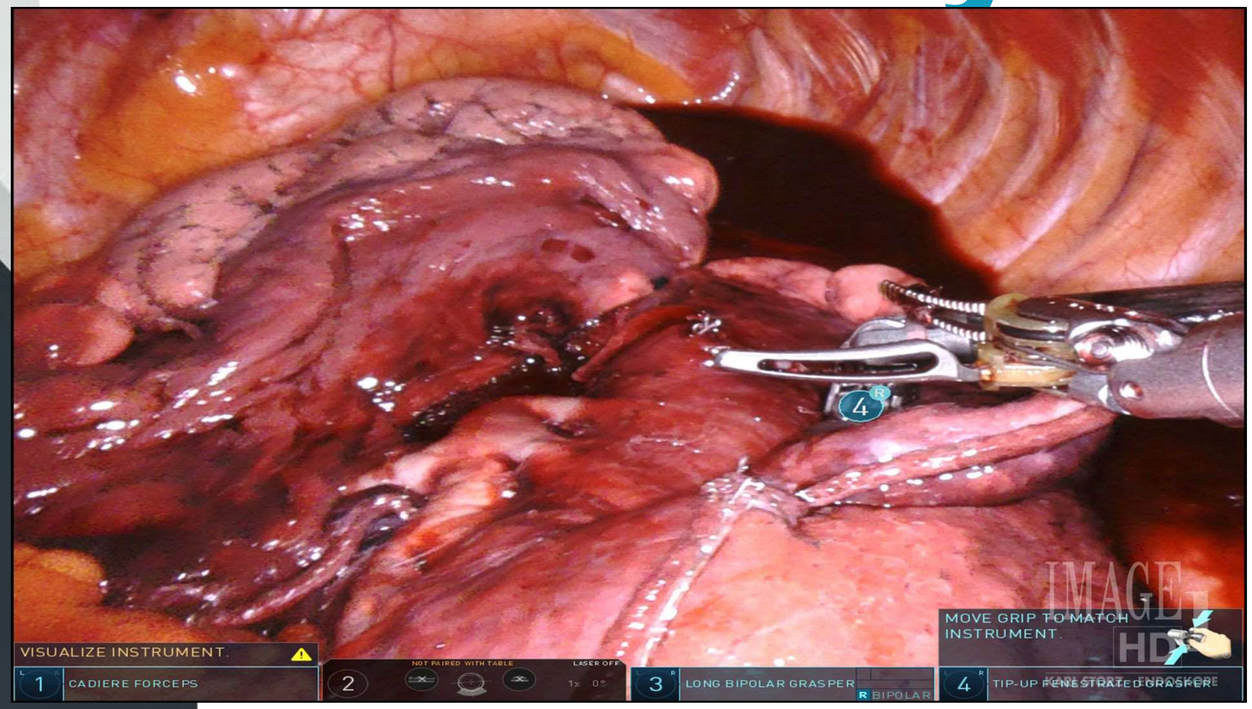
Lobectomy

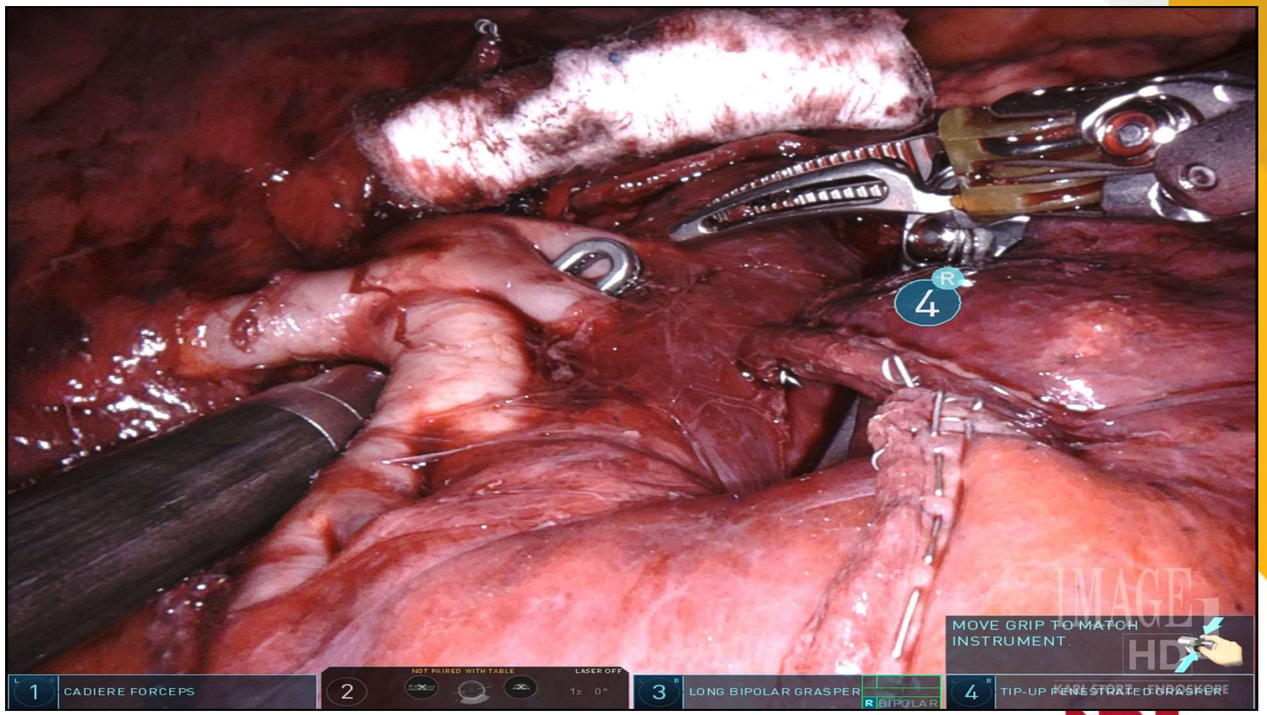

Horizontal fissure
Oblique fissure
Superior lobe
Middle lobe
Inferior lobe
Oblique fissure
Superior lobe
Inferior lobe

Lobectomy



Lobectomy


VISUALIZE INSTRUMENT.
1 CADIERE FORCEPS
2
NOT PAIRED WITH TABLE
LASER OFF
3 LONG BIPOLAR GRASPER
R BIPOLAR
4 TIP-UP FENESTRATED GRASPER
MOVE GRIP TO MATCH INSTRUMENT.
IMAGE1 HD


1 CADIERE FORCEPS
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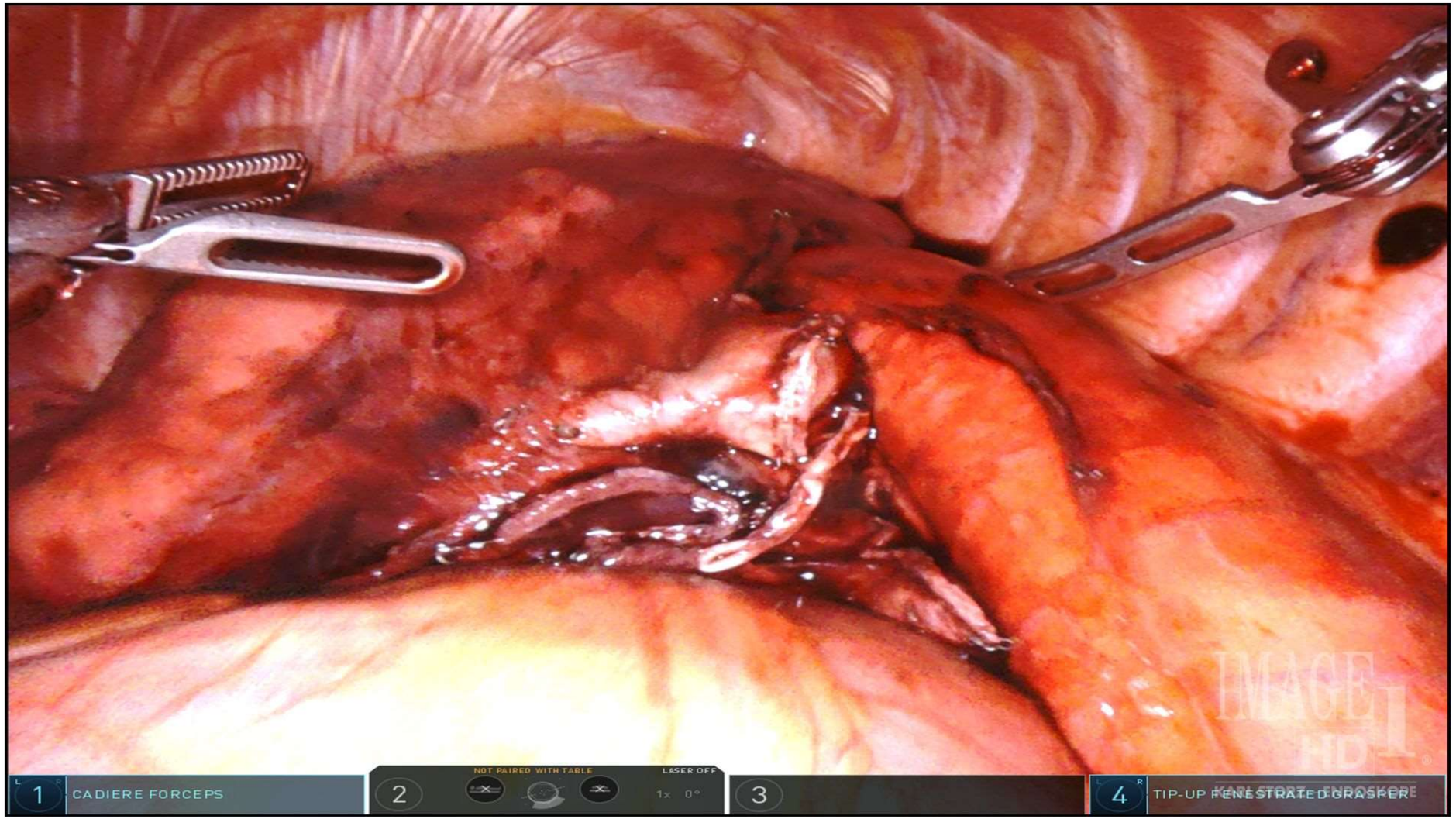
3 LONG BIPOLAR GRASPER
R BIPOLAR
4 TIP-UP FENESTRATED GRASPER
MOVE GRIP TO MATCH INSTRUMENT.
IMAGE1 HD

Lobectomy

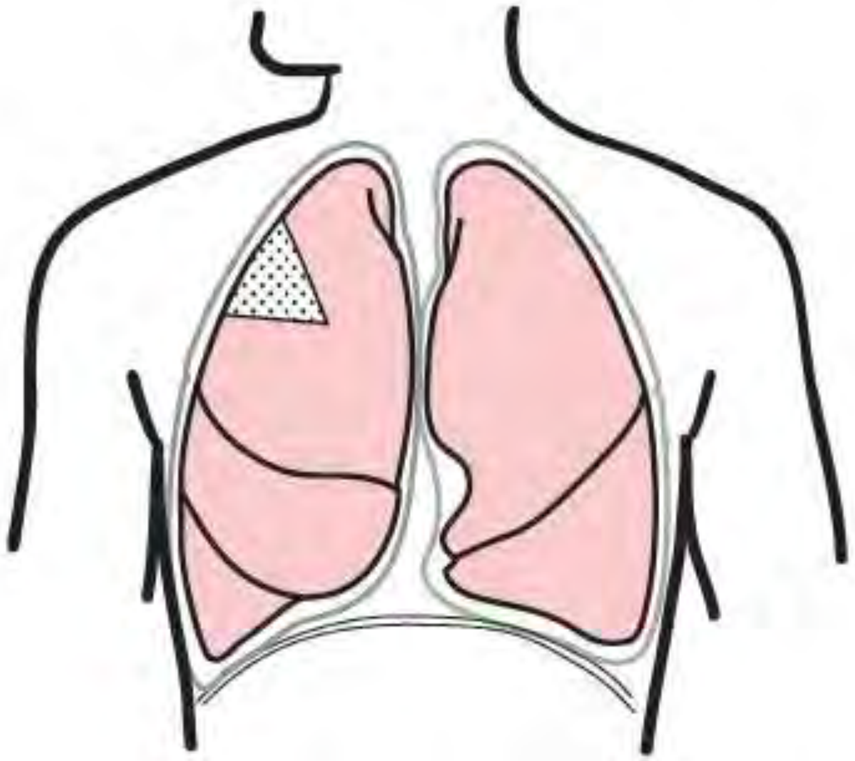

1
CADIERE FORCEPS
NOT PAIRED WITH TABLE
LASER OFF
2
1x 0°
3
4
TIP-UP FENESTRATED GRASPER

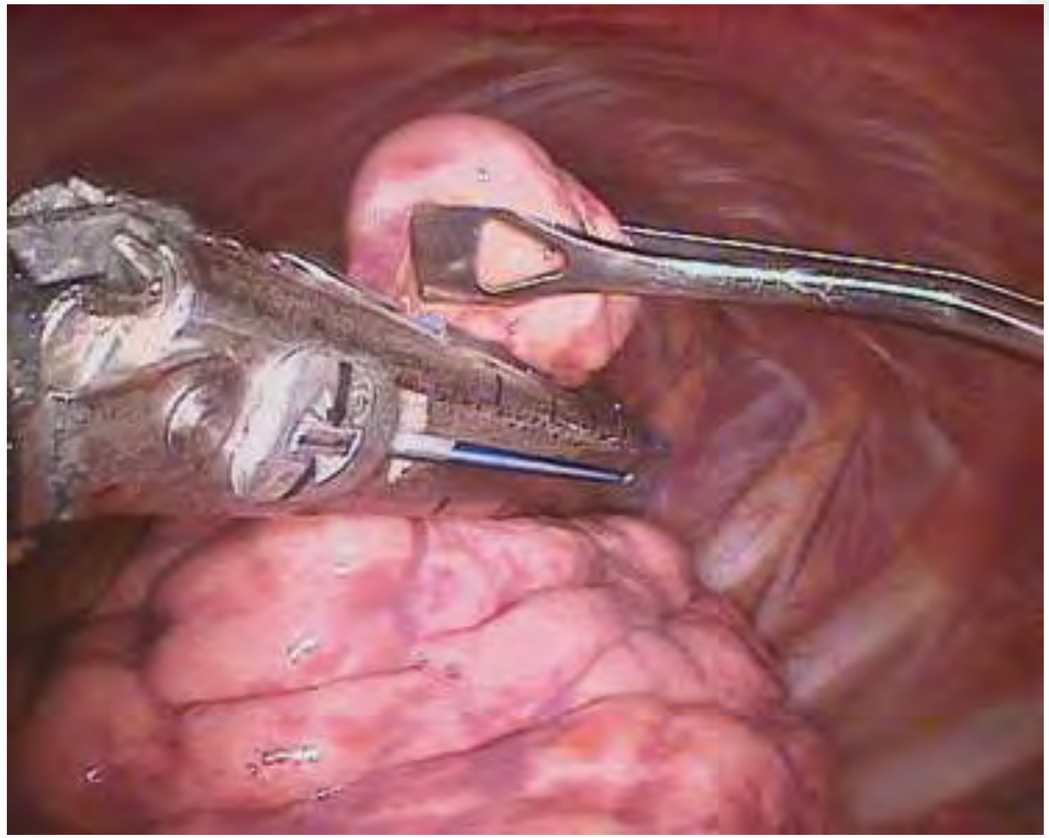
Sub-lobar Resections

Wedge Resection

Segmentectomy

Wedge Resection





Segmentectomy

“Limited pulmonary resection”

“Parenchymal sparing”

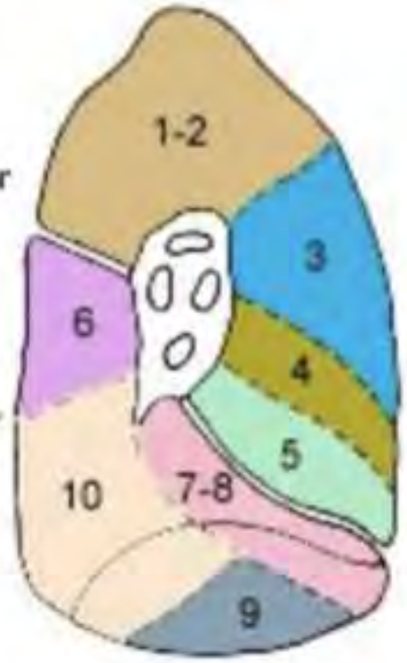
An anatomic resection of a single segment of the lung

Segments of the Lung

Right medial view

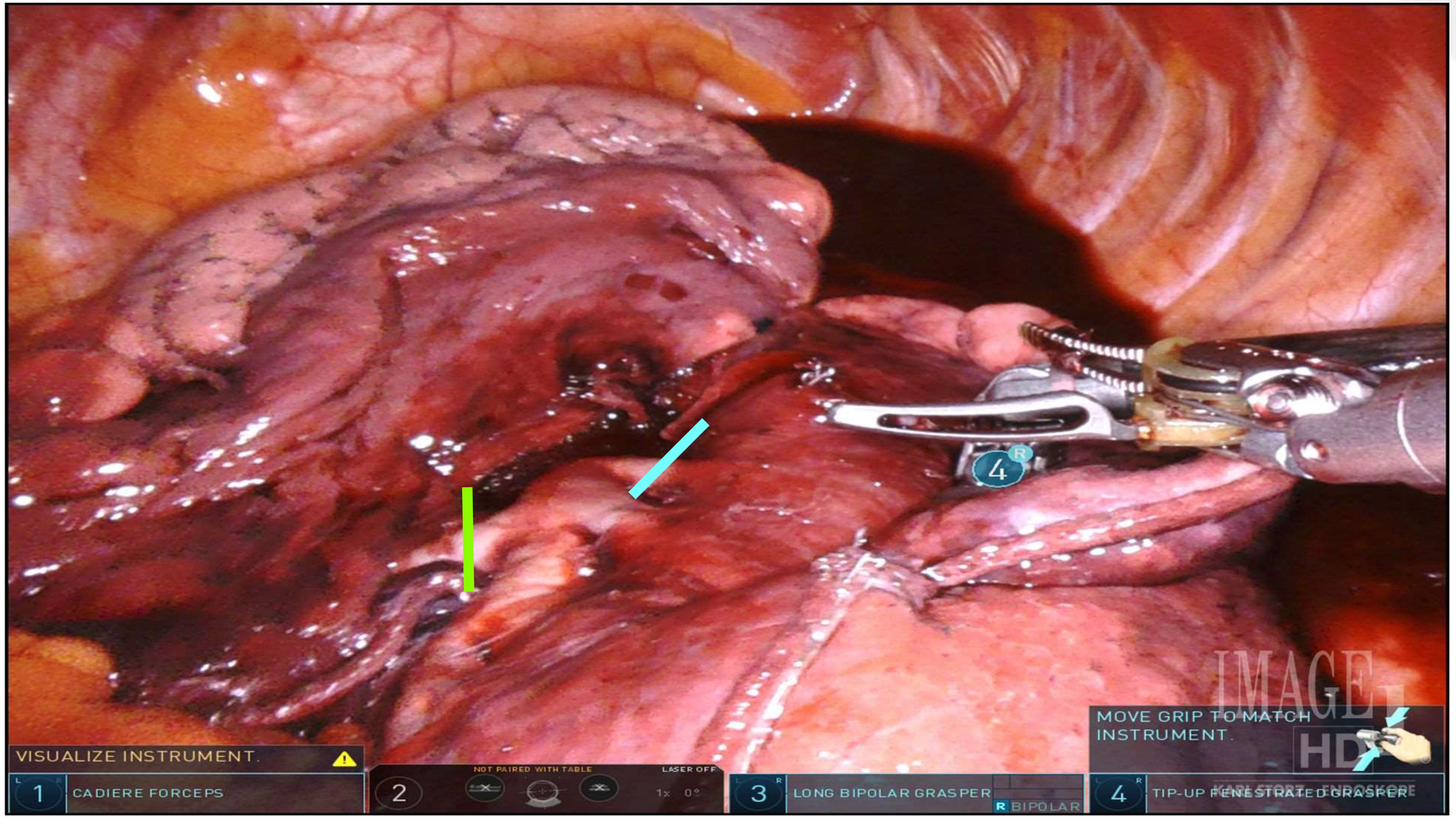
Upper lobe	1.	Apical
	2.	Posterior
	3.	Anterior
Middle lobe	4.	Lateral
	5.	Medial
Lower lobe	6.	Superior
	7.	Med. basal
	8.	Ant. basal
	9.	Lat. basal
	10.	Post. basal

1–2.	Apical-posterior	Upper lobe
3.	Anterior	
4.	Superior	Lingula
5.	Inferior	
6.	Superior	Lower lobe
7–8.	Ant. basal	
9.	Lat. basal	
10.	Post. basal	

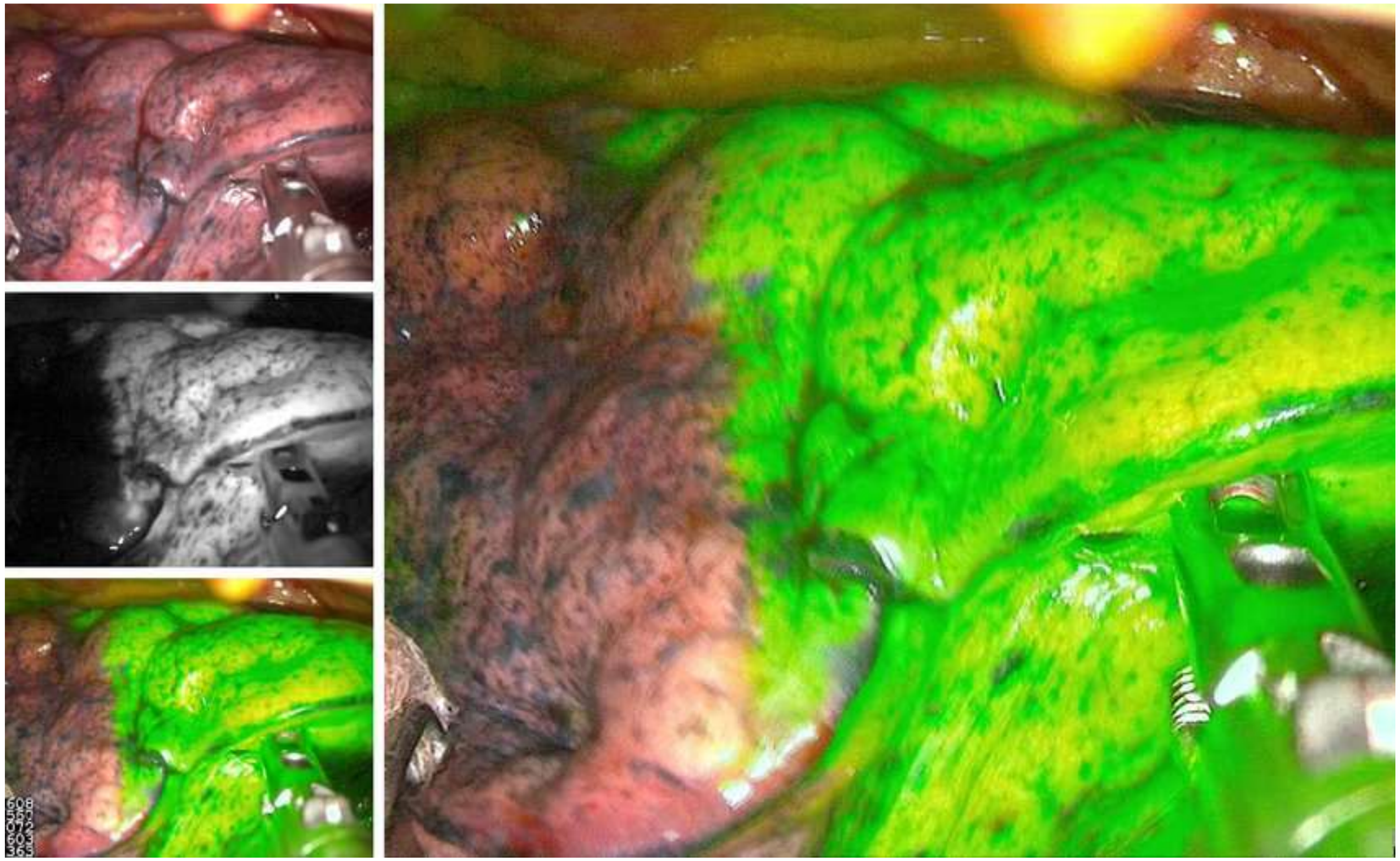


Left medial view

Segmentectomy

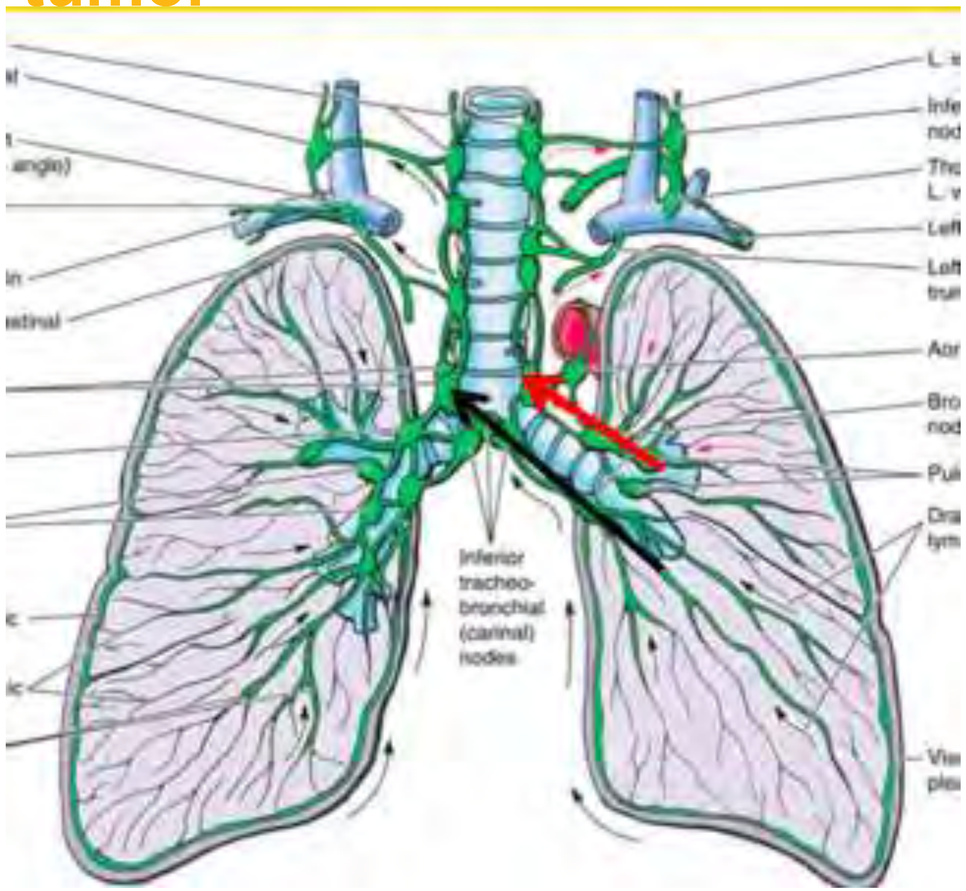


But There Are No Fissures?



Why Anatomic Resections?

Removing all the lymphatics draining the portion of the lung which has the tumor



Why Take Less Than a Lobe?

Patient would likely not tolerate removal of a whole lobe of the lung

- Marginal/Poor PFTs

And the lesion in question has favorable anatomy

- Small
- Peripheral
- Likely confined to an anatomic segment

Consequences of Taking Less Than the Entire Lobe

Worry about local recurrence

More difficult dissection

Randomized Trial of Lobectomy Versus Limited Resection for T1 N0 Non–Small Cell Lung Cancer

Lung Cancer Study Group (Prepared by Robert J. Ginsberg, MD, and Lawrence V. Rubinstein, PhD)

Prospective multi-institutional randomized trial

1982-1988

247 patients T1N0 NSCLC

Segments or large wedge (2 cm margins)

Followed q3 mo the first 2 years and q6 mo the next 3 years

(Ann Thorac Surg 1995;60:615–23)

Table 3. Recurrence and Death Rates for the 247 Eligible Patients on LCSG 821[a]

Event	Limited Resection		Lobectomy		p Value
	No. of Patients	Rate (per person/y)	No. of Patients	Rate (per person/y)	
Recurrence (excluding second primary)	38	0.101	23	0.057	0.02[b]
Recurrence (including second primary)	42	0.112	32	0.079	0.079[b]
Locoregional recurrence[d]	21	0.060	8	0.020	0.008[c]
Nonlocal recurrence[d]	17	0.048	15	0.037	0.672 (NS)[c]
Death (with cancer)	30	0.073	21	0.049	0.094[b]
Death (all causes)	48	0.117	38	0.089	0.088[b]

[a] Note locoregional recurrence rates and death rates are significantly increased after limited resection. [b] One-sided (refer to text); [c] two-sided (refer to text); [d] for definition of recurrences, refer to text.

NS = not significant.

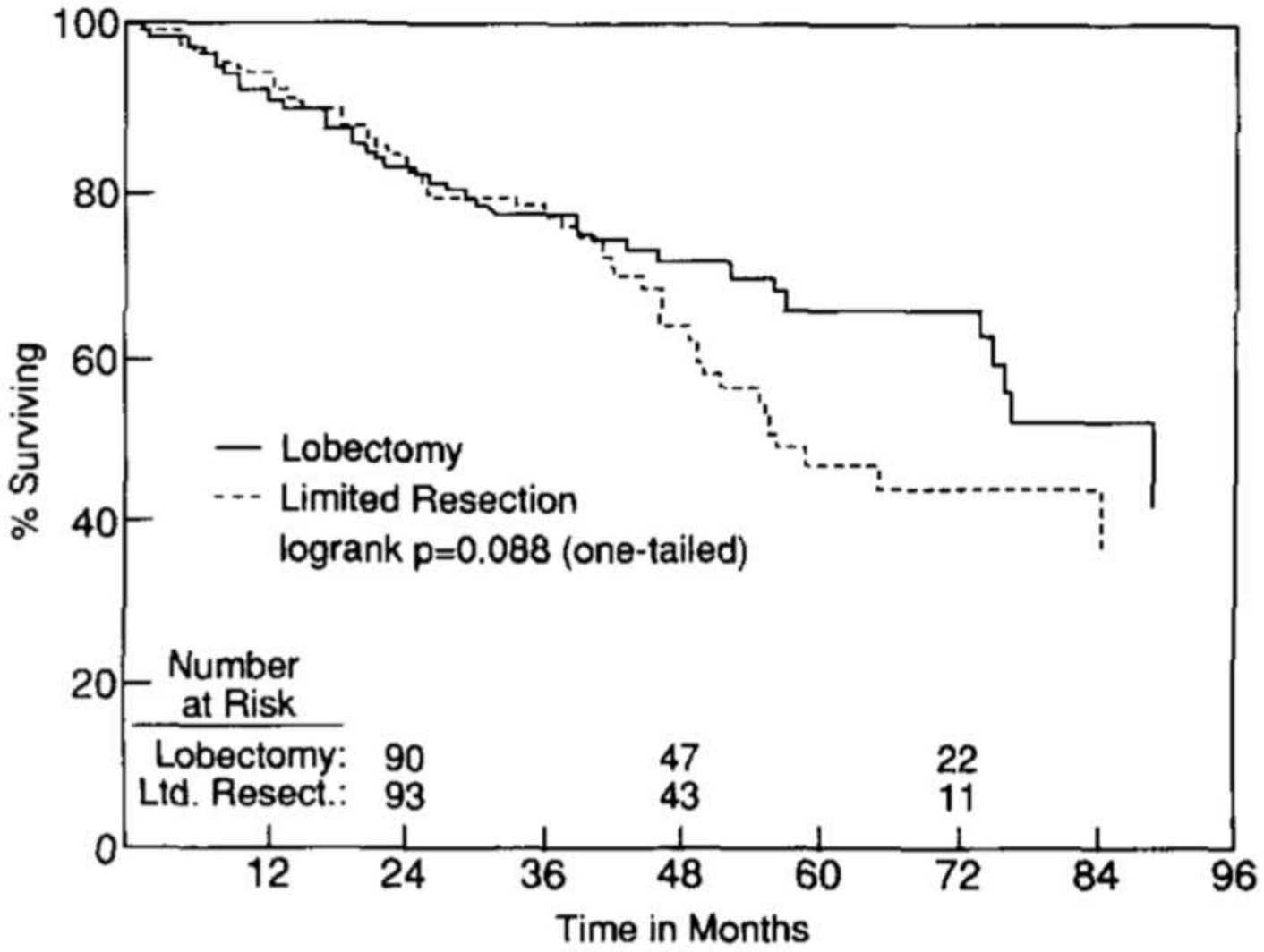


Fig 1. Time to death (from any cause) by treatment for 247 eligible patients.

Table 2. Stratification and Selected Prognostic Factors Variables for the 247 Eligible Patients in LCSG 821, Demonstrating No Significant Differences in Allocation

	Surgical Approaches			
	Limited Resection		Lobectomy	
Variables	No. of Patients	%	No. of Patients	%
Total no. of Patients	122		125	
Intended limited resection				
Wedge	40	32.8	40	32.0
Segmental	82	67.2	85	68.0
Performance status = 10	68	55.7	73	58.9
Preop $FEV_1 \geq 50\%$ predicted	114	93.4	116	92.8
Previous wt loss <10%	111	91.0	113	91.1
Nonsquamous histology	92	77.3	92	73.6
Previous cardiac disease	27	22.1	26	21.0
Preop WBC >9,100/μL	34	27.9	35	28.0
Age				
<60 y	45	37.0	38	30.0
≥60 y	77	63.0	86	69.0
Unknown	. . .		1	1.0

FEV_1 = 1 second forced expiratory volume; Preop = preoperative; WBC = white blood cell count.

Segmentectomy versus lobectomy in small-sized peripheral non-small-cell lung cancer (JCOG0802/WJOG4607L): a multicentre, open-label, phase 3, randomised, controlled, non-inferiority trial

*Hisashi Saji, Morihito Okada, Masahiro Tsuboi, Ryu Nakajima, Kenji Suzuki, Keiju Aokage, Tadashi Aoki, Jiro Okami, Ichiro Yoshino, Hiroyuki Ito, Norihito Okumura, Masafumi Yamaguchi, Norihiko Ikeda, Masashi Wakabayashi, Kenichi Nakamura, Haruhiko Fukuda, Shinichiro Nakamura, Tetsuya Mitsudomi, Shun-Ichi Watanabe, Hisao Asamura, on behalf of the West Japan Oncology Group and Japan Clinical Oncology Group**

Randomized control trial

- Lancet 2022
- 70 institutions across Japan
- Aug 2009 - Oct 2014
- 1106 patients

Primary outcome: Overall Survival

Secondary outcomes: Post op respiratory function, relapse free survival, Proportion of local relapse, adverse events, Proportion of completion segmentectomy, duration of hospital stay, duration of chest tube placement, duration of surgery, amount of blood loss, and the number of automatic surgical staples used

www.thelancet.com **Vol 399 April 23, 2022**

Inclusion

20-85 yo

ECOG 0 or 1

NSCLC

- ≤2cm
- Consolidation to tumor ratio >0.5
- Outer 1/3
- Clinical stage Ia

No previous ipsilateral thoracotomy

No chemo or radiation for any malignant diseases

Post op FEV1 of at least 800 mL

PaO2 65 torr

Exclusion

Active bacterial or fungal infection

Simultaneous or metachronous double cancers in the last 5 years

Pregnancy or breast feeding

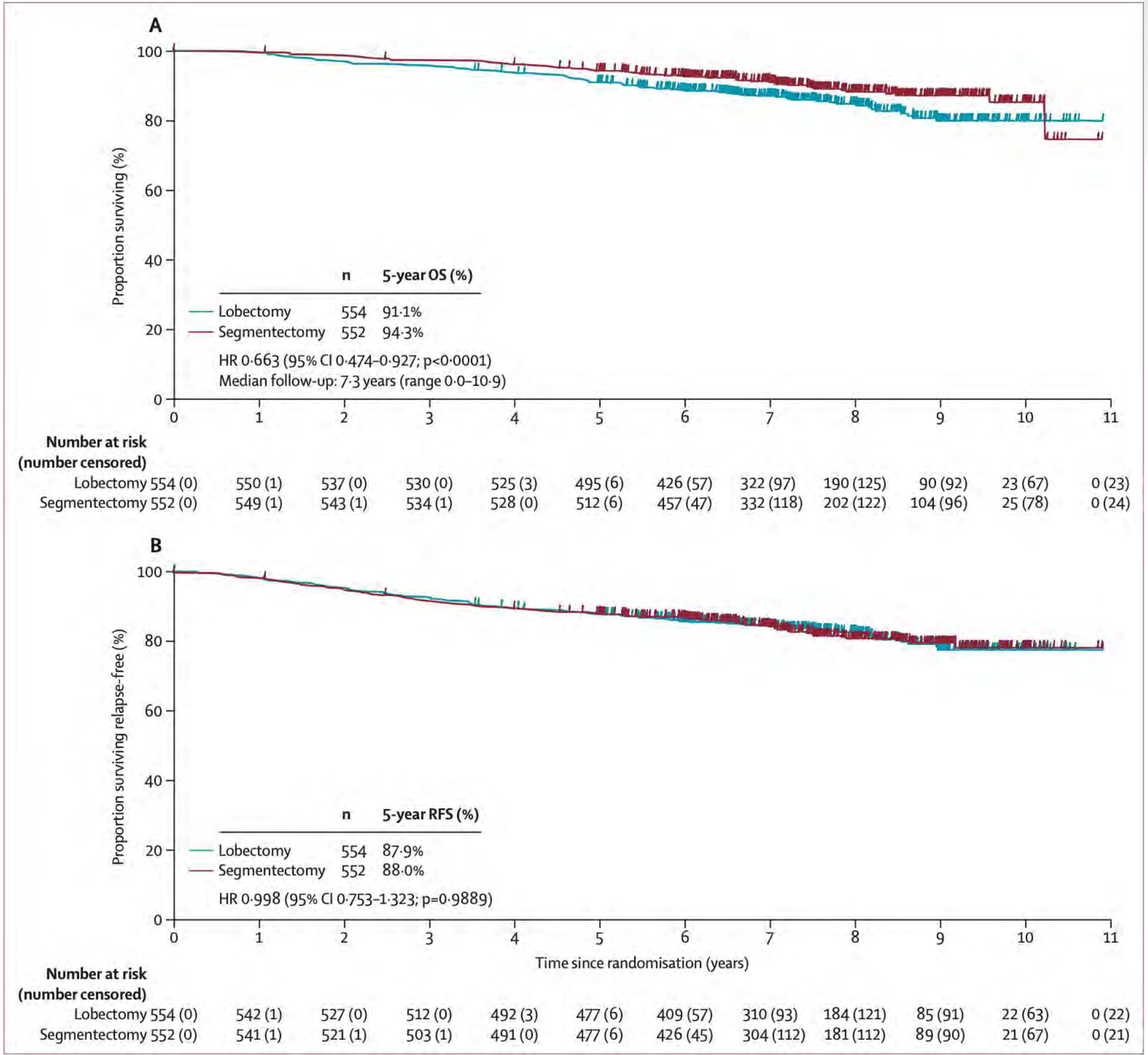
Interstitial lung disease or severe emphysema

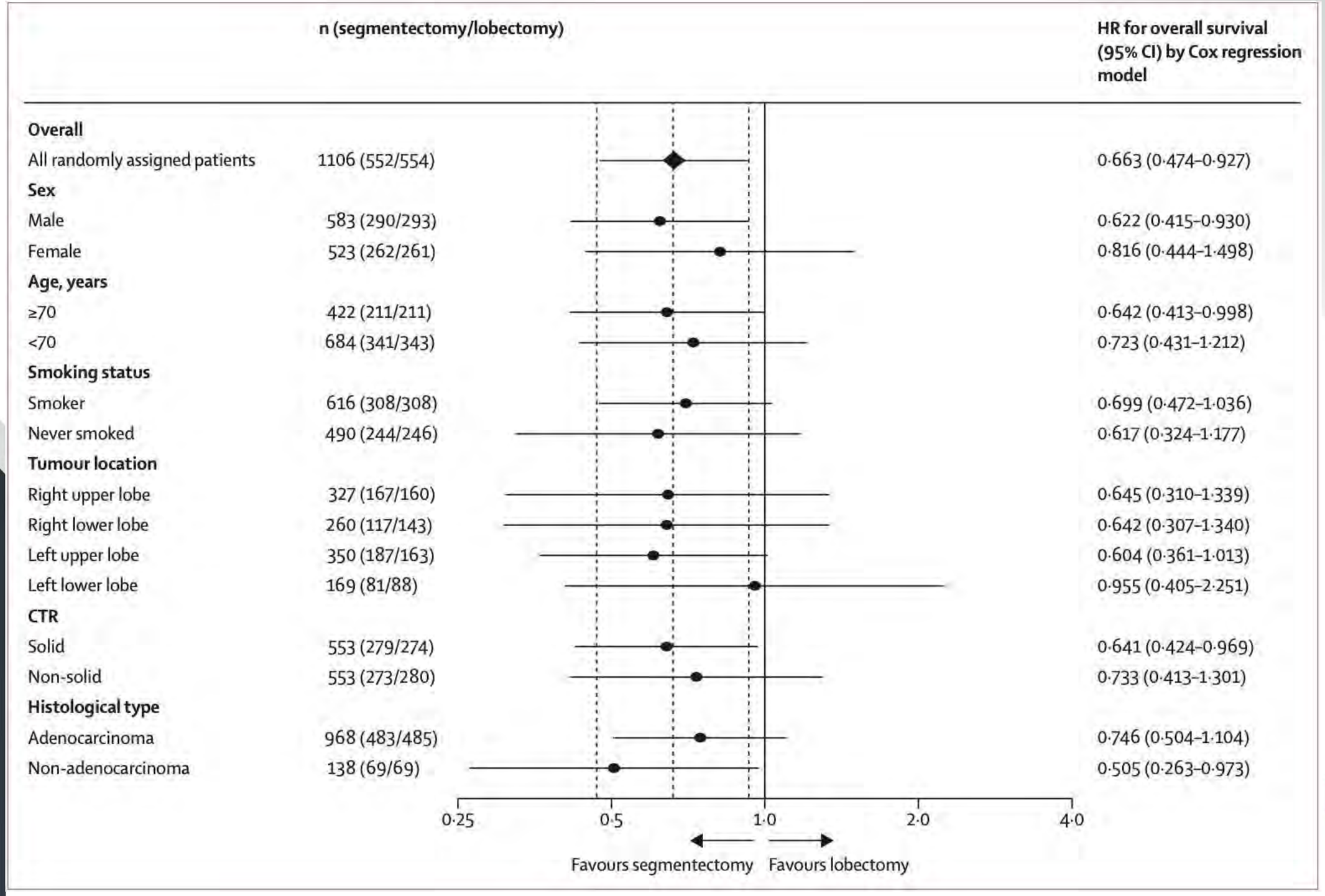
Psychosis

Systemic steroids

Uncontrolled DM or HTN

Severe heart disease


A
Proportion surviving (%)
100
80
60
40
20
0
n
5-year OS (%)
Lobectomy 554 91·1%
Segmentectomy 552 94·3%
HR 0·663 (95% CI 0·474–0·927; p<0·0001)
Median follow-up: 7·3 years (range 0·0–10·9)
0 1 2 3 4 5 6 7 8 9 10 11
Number at risk
(number censored)
Lobectomy 554 (0) 550 (1) 537 (0) 530 (0) 525 (3) 495 (6) 426 (57) 322 (97) 190 (125) 90 (92) 23 (67) 0 (23)
Segmentectomy 552 (0) 549 (1) 543 (1) 534 (1) 528 (0) 512 (6) 457 (47) 332 (118) 202 (122) 104 (96) 25 (78) 0 (24)
B
Proportion surviving relapse-free (%)
100
80
60
40
20
0
n
5-year RFS (%)
Lobectomy 554 87·9%
Segmentectomy 552 88·0%
HR 0·998 (95% CI 0·753–1·323; p=0·9889)
0 1 2 3 4 5 6 7 8 9 10 11
Time since randomisation (years)
Number at risk
(number censored)
Lobectomy 554 (0) 542 (1) 527 (0) 512 (0) 492 (3) 477 (6) 409 (57) 310 (93) 184 (121) 85 (91) 22 (63) 0 (22)
Segmentectomy 552 (0) 541 (1) 521 (1) 503 (1) 491 (0) 477 (6) 426 (45) 304 (112) 181 (112) 89 (90) 21 (67) 0 (21)


n (segmentectomy/lobectomy)
HR for overall survival (95% CI) by Cox regression model
Overall
All randomly assigned patients
1106 (552/554)
0·663 (0·474–0·927)
Sex
Male
583 (290/293)
0·622 (0·415–0·930)
Female
523 (262/261)
0·816 (0·444–1·498)
Age, years
≥70
422 (211/211)
0·642 (0·413–0·998)
<70
684 (341/343)
0·723 (0·431–1·212)
Smoking status
Smoker
616 (308/308)
0·699 (0·472–1·036)
Never smoked
490 (244/246)
0·617 (0·324–1·177)
Tumour location
Right upper lobe
327 (167/160)
0·645 (0·310–1·339)
Right lower lobe
260 (117/143)
0·642 (0·307–1·340)
Left upper lobe
350 (187/163)
0·604 (0·361–1·013)
Left lower lobe
169 (81/88)
0·955 (0·405–2·251)
CTR
Solid
553 (279/274)
0·641 (0·424–0·969)
Non-solid
553 (273/280)
0·733 (0·413–1·301)
Histological type
Adenocarcinoma
968 (483/485)
0·746 (0·504–1·104)
Non-adenocarcinoma
138 (69/69)
0·505 (0·263–0·973)
0·25
0·5
1·0
2·0
4·0
Favours segmentectomy
Favours lobectomy

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Lobar or Sublobar Resection for Peripheral Stage IA Non–Small-Cell Lung Cancer

Nasser Altorki, M.D., Xiaofei Wang, Ph.D, David Kozono, M.D., Ph.D., Colleen Watt, B.S., Rodney Landrenau, M.D., Dennis Wigle, M.D., Ph.D., Jeffrey Port, M.D., David R. Jones, M.D., Massimo Conti, M.D., Ahmad S. Ashrafi, M.D., Moishe Liberman, M.D., Ph.D., Kazuhiro Yasufuku, M.D., Ph.D., Stephen Yang, M.D., John D. Mitchell, M.D., Harvey Pass, M.D., Robert Keenan, M.D., Thomas Bauer, M.D., Daniel Miller, M.D., Leslie J. Kohman, M.D., Thomas E. Stinchcombe, M.D., and Everett Vokes, M.D.

Randomized Non-Inferiority Trial

- 83 institutions in the United States, Canada, and Australia
- NSCLC T1aN0
- Sublobar = segmentectomy or wedge resection
- June 2007 - March 2017
- 697 patients

Primary end point: disease free survival

Secondary end points: overall survival, , locoregional and systemic recurrence, expiratory flow rates 6 months postop

Pre-op Eligibility

Lung nodule with a solid component of 2 cm or less

Presumed or confirmed to be NSCLC

Outer third of the lung

ECOG of 0,1, or 2

No malignant disease in the last 3 years

No chemo/rads for the lung cancer

No advanced or metastatic disease

≥18 yo

Intra-op Eligibility

Histologic confirmation of NSCLC

Confirmation of N0 status by means of frozen sections of mediastinal and hisar nodes

- Previously sampled nodes in the last 6 weeks did not need to be re-sampled

The type of sublunar resection (wedge resection or segmentectomy) and the choice of surgical approach (thoracotomy vs. video or robotic assisted thoracoscopic surgery) was at the surgeon's discretion

357 lobectomies

340 sub-lobar resections

- 201 wedge resections
- 129 segmentectomies

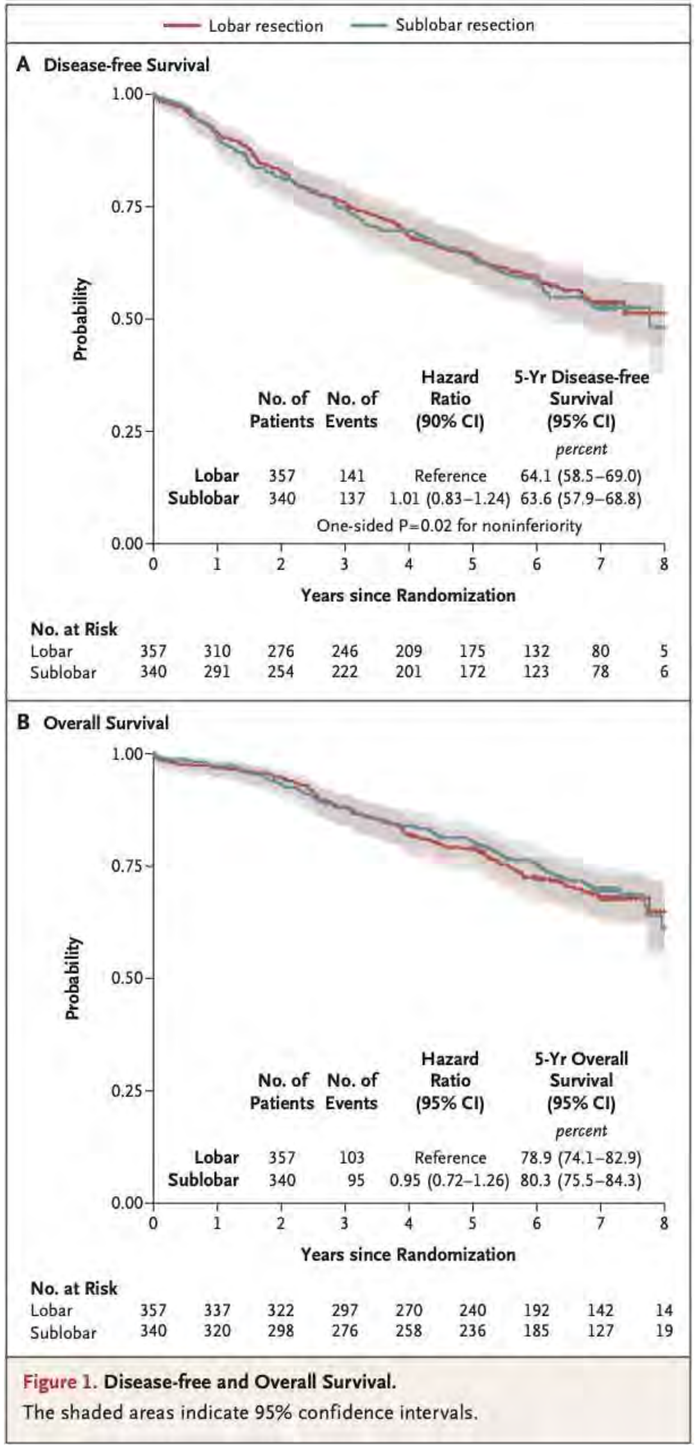


Figure 1. Disease-free and Overall Survival.
The shaded areas indicate 95% confidence intervals.

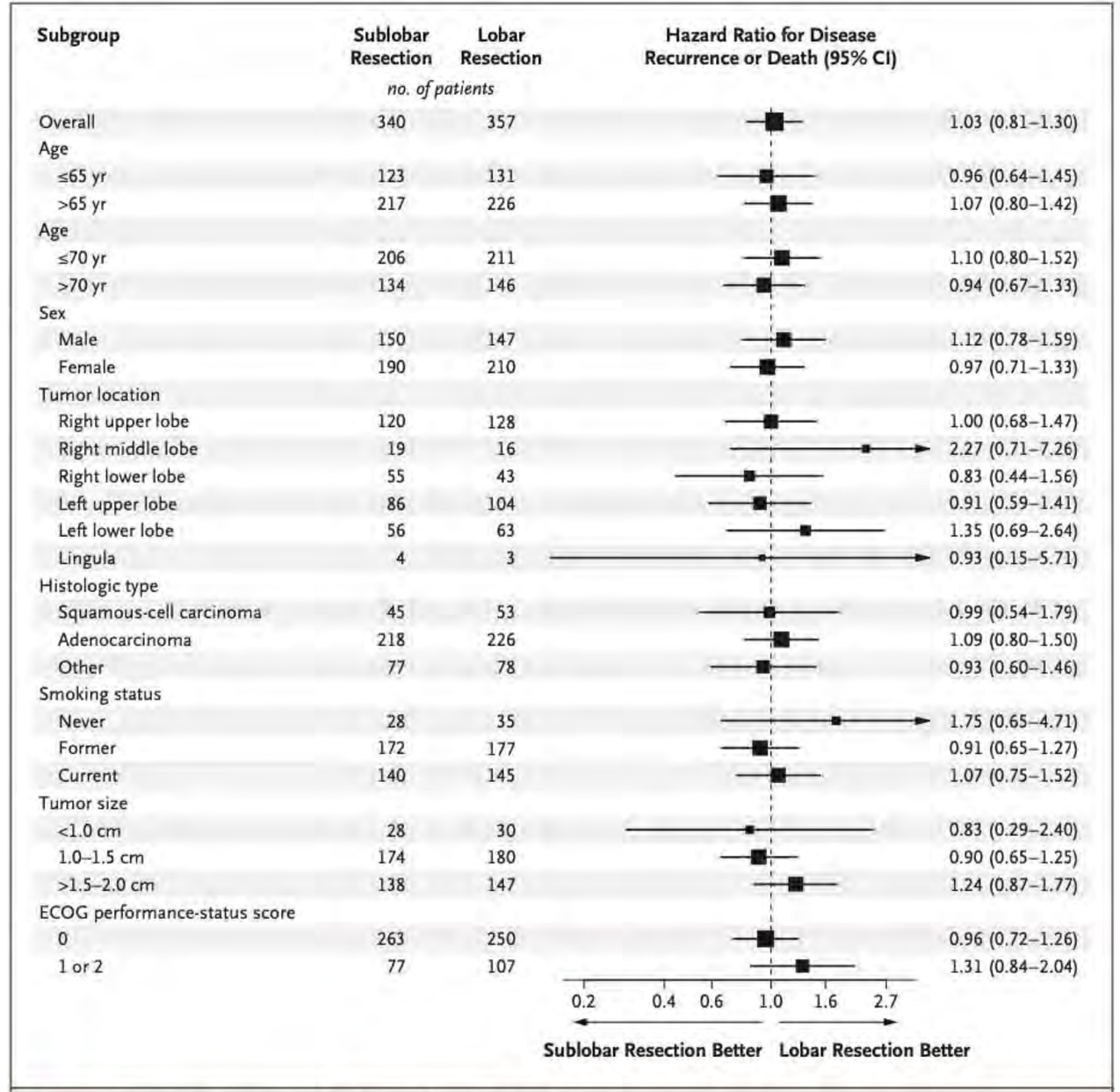


Figure 2. Exploratory Subgroup Analysis of Disease-free Survival.

Hazard ratios and 95% confidence intervals were estimated with the use of unstratified Cox proportional-hazards models. The size of the squares indicating the hazard ratios is proportional to the number of patients included in the analysis. Eastern Cooperative Oncology Group (ECOG) performance-status scores range from 0 to 5, with higher scores indicating greater disability.

What About SBRT?

A Propensity-Matched Analysis of Wedge Resection and Stereotactic Body Radiotherapy for Early Stage Lung Cancer

Jeffrey L. Port, MD,* Bhupesh Parashar, MD,* Nonso Osakwe, MD, Abu Nasar, MS, Paul C. Lee, MD, Subroto Paul, MD, Brendon M. Stiles, MD, and Nasser K. Altorki, MD

Division of Thoracic Surgery, Department of Cardiothoracic Surgery, and Department of Radiation Oncology, New York Presbyterian Hospital, Weill Medical College of Cornell University, New York, New York

Review of prospectively collected database 2001 - 2012

Stage Ia NSCLC

Surgery for those who had a previous lobe (excluding middle) or marginal PFTs

Wedge margins were the size of the tumor diameter or at least 1 cm

Brachytherapy for some

99 patients propensity matched

Ann Thorac Surg
2014;98:1152–9

Table 3. Pathologic Upstaging in the Wedge Group

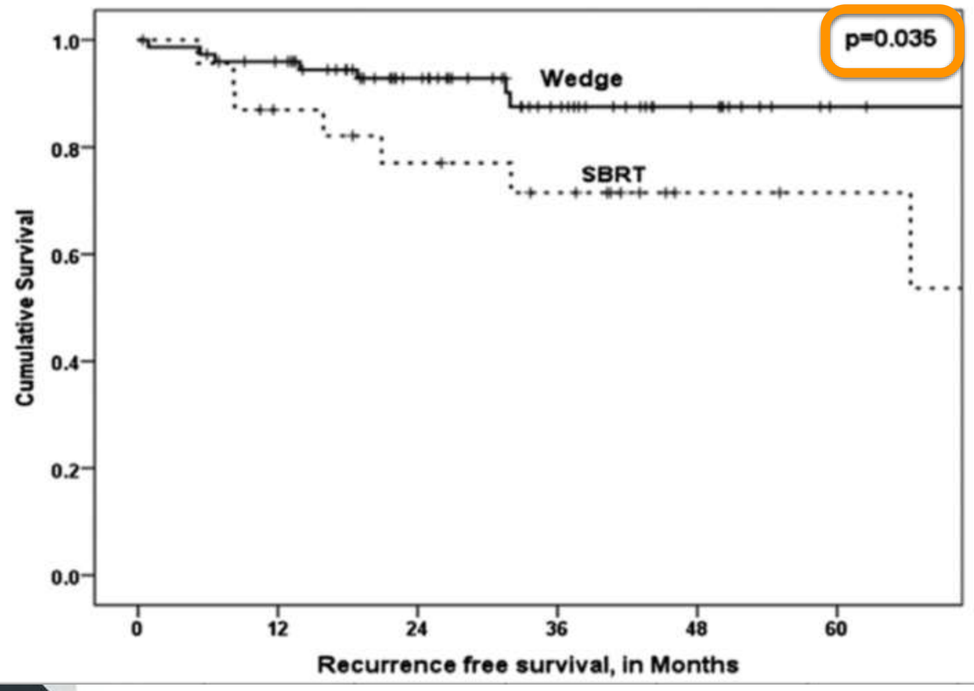
Pathologic upstaging in T in the wedge group							
Total path T stage							
cT	n	Upstaged	T1a	T1b	T2a	T3	T4
T1a	60	11 (18%)	49 (82%)	3 (5%)	5 (7%)	3 (5%)	0
T1b	16	5 (31%)	9 (56%)	2 (13)	3 (19%)	1 (6%)	1 (6%)

Pathologic upstaging in N for wedge group	
Path 'N' status	Wedge
Nx/N0	74 (97%)
N2	2 (3%)

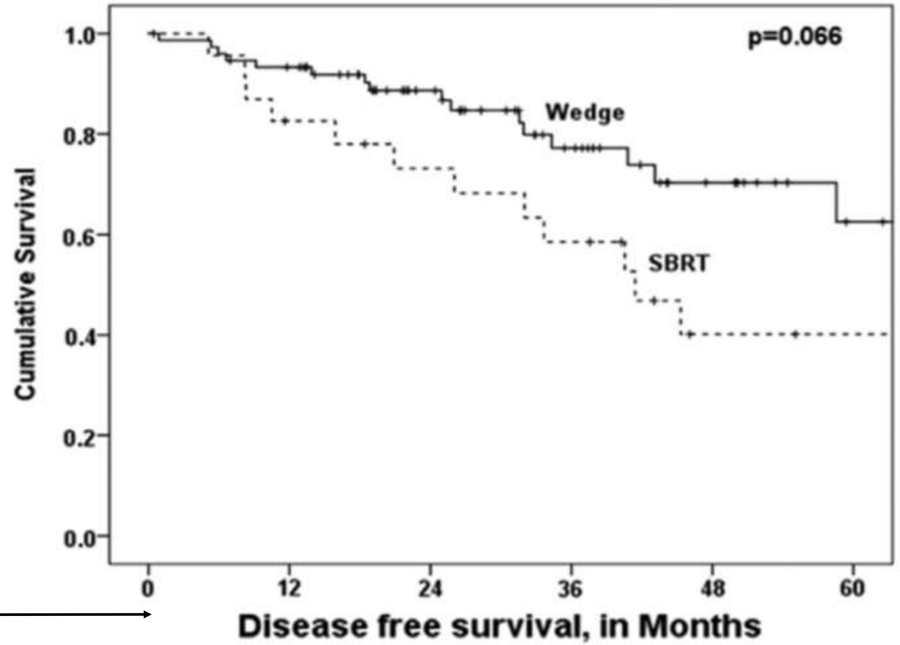
Table 5. Recurrence by Treatment

Recurrence Type	Wedge (± Brachy) (n = 76)	SBRT (n = 23)	*p* Value
Locoregional	3 (4%)	3 (13%)	
Distant	4 (5%)	4 (17%)	0.016
No recurrence	69 (91%)	16 (70%)	

Brachy = brachytherapy; SBRT = stereotactic body radiotherapy.



Includes distant mets →



Stereotactic Body Radiation Therapy Versus Surgery for Early Lung Cancer Among US Veterans

Alex K. Bryant, BS, Robert C. Mundt, HSDG, Ajay P. Sandhu, MD, James J. Urbanic, MD, Andrew B. Sharabi, MD, PhD, Samir Gupta, MD, Megan E. Daly, MD, and James D. Murphy, MD, MS

Department of Radiation Medicine and Applied Sciences, Division of Gastroenterology, Department of Medicine, and Clinical and Translational Research Institute, University of California San Diego, La Jolla; and Department of Radiation Oncology, University of California Davis, Davis, California

T1 or T2a N0 M0, biopsy proven, 2006 - 2015

4069 patients

VA Informatics and Computing Infrastructure (VINCI)

2986 lobes

634 sublobes

449 received SBRT

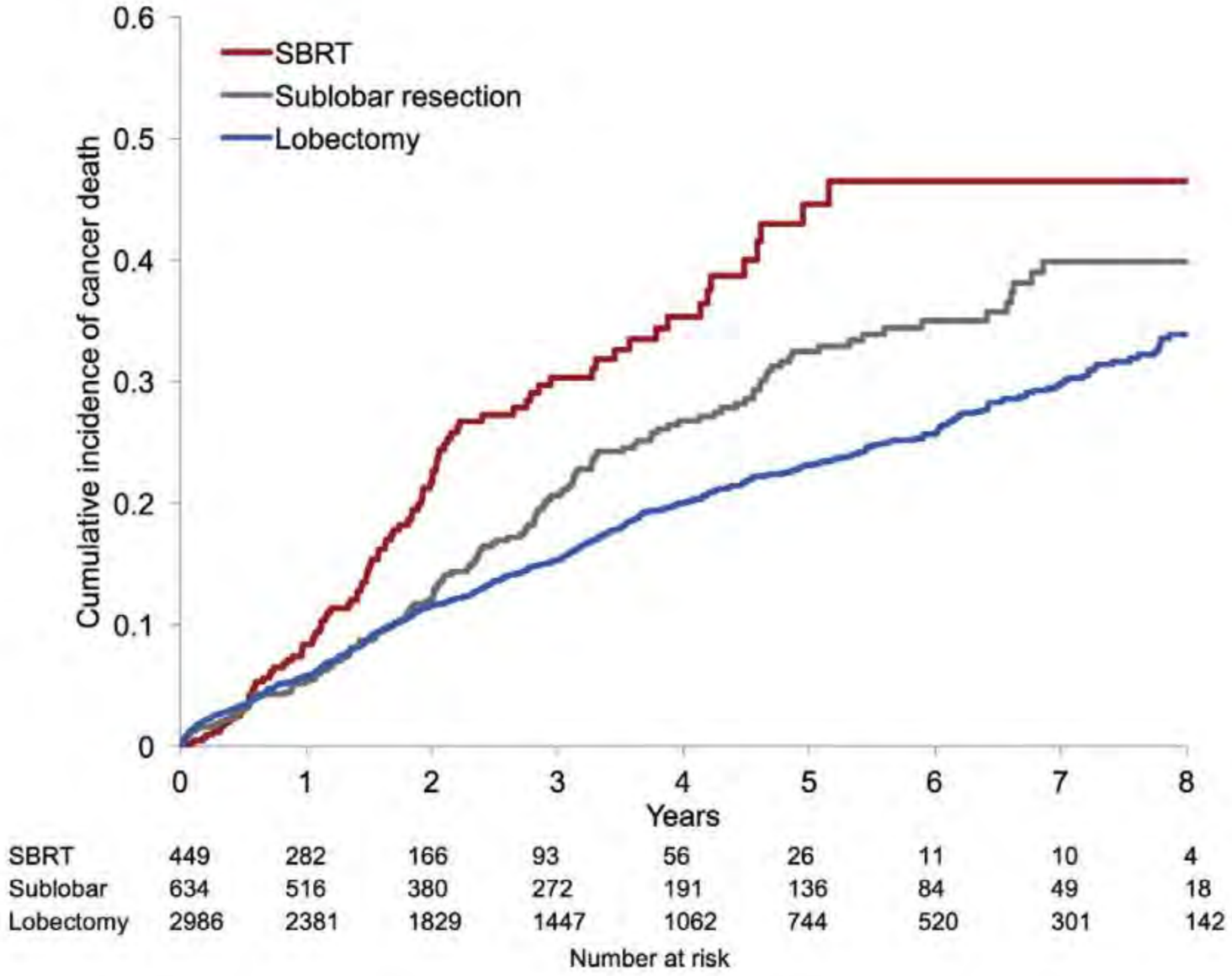

SBRT
Sublobar resection
Lobectomy
Cumulative incidence of cancer death
0.6
0.5
0.4
0.3
0.2
0.1
0
0 1 2 3 4 5 6 7 8
Years
SBRT 449 282 166 93 56 26 11 10 4
Sublobar 634 516 380 272 191 136 84 49 18
Lobectomy 2986 2381 1829 1447 1062 744 520 301 142
Number at risk

Table 2. Summary of Multivariable Regression Results

	SBRT Versus Lobectomy			SBRT Versus Sublobar Resection		
Outcome	SDHR[a]	95% CI	*p* Value	SDHR[a]	95% CI	*p* Value
Cancer-specific survival	1.45	1.09–1.94	0.01	1.25	0.93–1.68	0.15
Noncancer survival	1.13	0.69–1.86	0.62	0.97	0.58–1.63	0.91
Overall survival	1.38	1.08–1.78	0.01	1.17	0.90–1.53	0.85

[a] Results are expressed as subdistribution hazard ratio (SDHR) for cancer-specific and noncancer survival, and hazard ratio for overall survival.

Results of multivariable Fine-Gray regressions for cancer-specific survival and noncancer survival, and Cox regression analysis for overall survival.

CI = confidence interval; SBRT = stereotactic body radiation therapy.

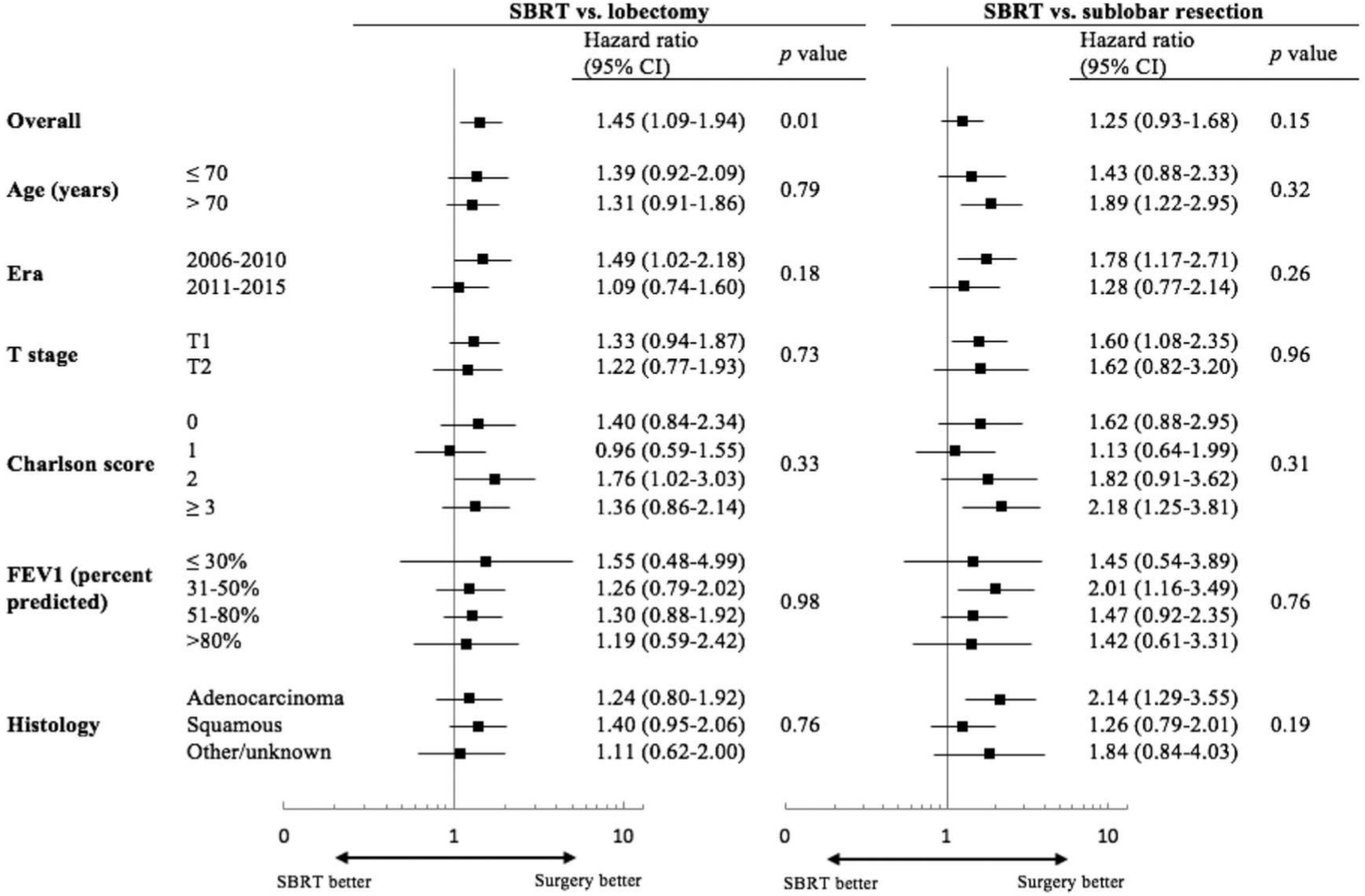


Fig 3. Forest plots illustrating the effects of treatment on different subgroups of patients with stage I non-small cell lung cancer. The plot represents the results of multivariable Fine-Gray regressions to evaluate the risk of cancer-related death for stereotactic body radiation therapy (SBRT) versus lobectomy (left plot) and SBRT versus sublobar resection (right plot). The p values represent an interaction term in the model. (CI = confidence interval; FEV_1 = forced expiratory volume in 1 second.)

PRINCIPLES OF SURGICAL THERAPY

Resection

- **Anatomic pulmonary resection is preferred for the majority of patients with NSCLC.**
- **Sublobar resection - Segmentectomy and wedge resection should be strongly considered for peripheral T1ab, N0 tumors.[1]**
- **Sublobar resection should achieve parenchymal resection margins ≥2 cm or ≥ the size of the nodule.**
- **Sublobar resection should also sample appropriate N1 and N2 lymph node stations unless not technically feasible without substantially increasing the surgical risk.**
- **Segmentectomy (preferred) or wedge resection is appropriate in selected patients with poor pulmonary reserve or other major comorbidity that contraindicates lobectomy.**
- **Minimally invasive surgery (VATS or robotic-assisted approaches) should be strongly considered for patients with no anatomic or surgical contraindications, as long as there is no compromise of standard oncologic and dissection principles of thoracic surgery. Robotic surgery should only be initiated by surgeons who have completed and maintained proficiency in the technique.**
- **In high-volume centers with significant VATS experience, VATS lobectomy in selected patients results in improved early outcomes (ie, decreased pain, reduced hospital length of stay, more rapid return to function, fewer complications) without compromise of cancer outcomes.**
- **Studies of robotic-assisted pulmonary resection show non-inferiority to traditional VATS approaches when performed by experienced robotic surgeons.[2,3]**
- **Lung-sparing anatomic resection (sleeve lobectomy) is preferred over pneumonectomy, if anatomically appropriate and margin-negative resection is achieved.**
- **T3 (invasion) and T4 local extension tumors require en-bloc resection of the involved structure with negative margins. If a surgeon or center is uncertain about potential complete resection, consider obtaining an additional surgical opinion from a high-volume specialized center.**

Evaluation (NSCL-B 1 of 6)
Margins and Nodal Assessment (NSCL-B 3 of 6)

The Role of Surgery in Patients with N2 NSCLC (NSCL-B 3 of 6 through NSCL-B 5 of 6)

References

Note: All recommendations are category 2A unless otherwise indicated.

Resection

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American Society of Radiation Oncologists (ASTRO) 2017 Guidelines

- *Standard risk*: For stage I NSCLC patients with anticipated risk of operative mortality of less than 1.5 percent, SBRT is not recommended as an alternative to surgery outside of clinical trial settings. The recommended treatment for these patients remains lobectomy with systematic mediastinal lymph node evaluation.

- *High risk*: For stage I NSCLC patients at greater risk of surgical morbidity or mortality or those who cannot tolerate a lobectomy but are candidates for sublobar resection, discussions about SBRT as an alternative to surgery are endorsed. Providers should inform patients that while short-term, treatment-related risks may be lower with SBRT, long-term outcomes (meaning longer than 3 years) are not yet well-established in the literature.

- A thoracic surgeon should evaluate any potentially medically operable early-stage NSCLC patient considering SBRT, preferably in a multidisciplinary setting, to reduce potential specialty bias.

Objectives

1. To compare the clinical effectiveness of lobectomy and sub-lobar resection for Stage I lung cancer patients.

2. To evaluate the impact of lobectomy and sub-lobar resection on patient quality of life and postoperative recovery.

3. To recommend a patient-centered approach for choosing between lobectomy and wedge resection in Stage I lung cancer.