Thoracoscopic sublobar resection for bronchial carcinoma

Postoperative outcome

Geneva, April 14th 2016

Dominique Gossot
Thoracic Department
IMM - Paris

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Disclosure

Consultant for instruments manufacturer
(Delacroix-Chevalier)

Sublobar resection for lung cancer:

What matters ?

- Oncological value and survival
- Postoperative outcome

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Why outcome is an issue ?

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

- Wedge resection (SLR) versus SBRT
- 99 patients
- Local recurrence — SBRT: 30%, SLR: 9%
- DF survival — SBRT: 59%, SLR: 77% (NS)
- Overall survival — SBRT: 72%, SLR: 88% (p:0.0001)

Ann Thorac Surg 2014;98:1152-9

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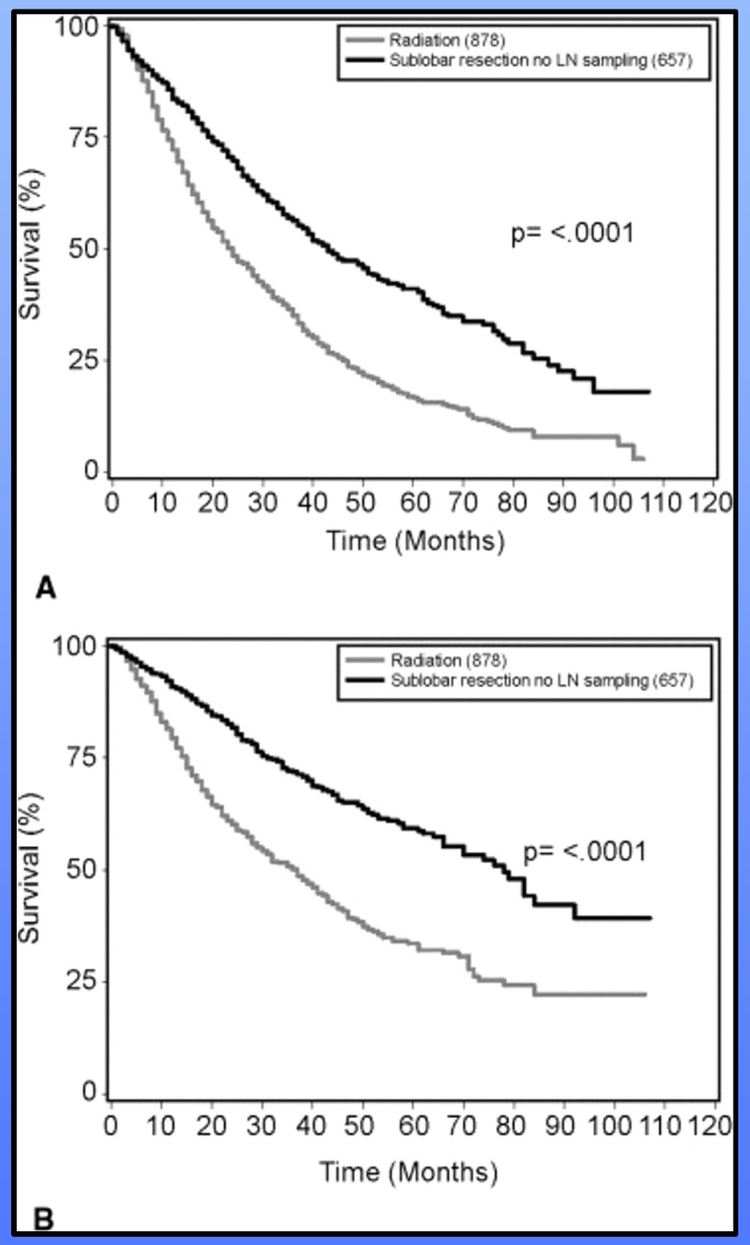
Why outcome is an issue ?

Sublobar Resection Versus Definitive Radiation in Patients With Stage IA Non-Small Cell Lung Cancer

Felix G. Fernandez, MD, Traves D. Crabtree, MD, Jingxia Liu, PhD, and Bryan F. Meyers, MD, MPH

Section of General Thoracic Surgery, Emory University School of Medicine, Atlanta, Georgia; Section of General Thoracic Surgery, Washington University School of Medicine, St. Louis, Missouri; and Division of Biostatistics, Washington University in St. Louis, St. Louis, Missouri

- Stades IA
- 878 patients : SBRT
- 657 patients : Sublobar resection (without LN dissection)
- 3-Years overall survival: 56% vs 35%



Better results, but …

Fernandez FG et al. Ann Thorac Surg 2012;94:354-361

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Why outcome is an issue ?

Predictors of Mortality After Surgical Management of Lung Cancer in the National Cancer Database

Joshua E. Rosen, BASc, Jacquelyn G. Hancock, BS, Anthony W. Kim, MD, Frank C. Detterbeck, MD, and Daniel J. Boffa, MD
Department of Thoracic Surgery, Yale University School of Medicine, New Haven, Connecticut

NCDB 2004-2009

N= 119146 patients

D30 mortality

- Standard lobectomies : 2.6%
- Extended lobectomies : 4%

Ann Thorac Surg 2014; 98:1953-1960

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Why outcome is an issue ?

Treatment of stage I lung cancer in high-risk and inoperable patients: SBRT *vs*. RFA *vs*. sublobar resection

Matthew J. Bott, Traves Crabtree

Division of Thoracic Surgery, Washington University School of Medicine, St. Louis, Missouri, USA

- Morbidity analysis
- on 3 ongoing prospective studies: SBRT *vs* RFA *vs* SLR

	SBRT RTOG0236	SLR ACOSOG Z4032	RFA ACOSOG Z4033
Mortality at D90	0 %	2.4%	2.0%
Complications at D30	-	28 %	2.0%

Ann Cardiothorac Surg 2014;3:167-9

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This means

- Surgery is doing better in terms of
  - local recurrence
  - survival
- But much worse in terms of
  - Mortality
  - Morbidity

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What we are talking about (technical points)

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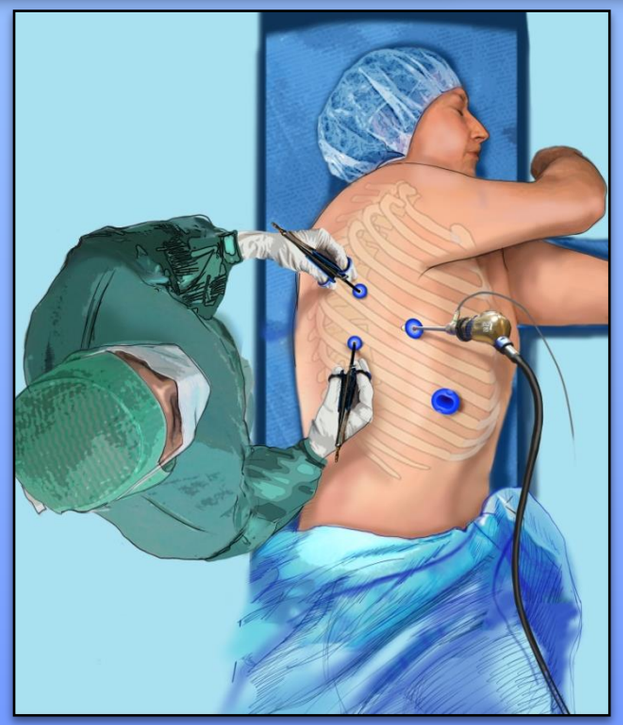
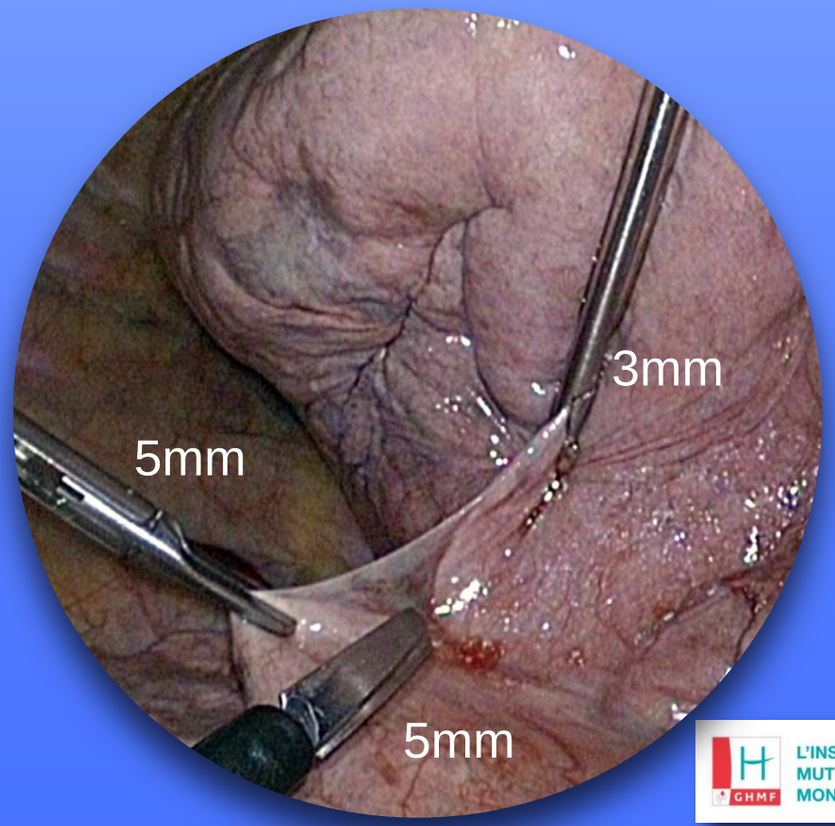
Technical aspect

- 3D reconstruction
- Trocars only (multiple ports)
- No access incision
- Deflectable scope
- Frozen section on
  - intersegmental lymph nodes, if any doubt
  - resection margin, if < 2 cm
- Radical mediastinal lymph node dissection





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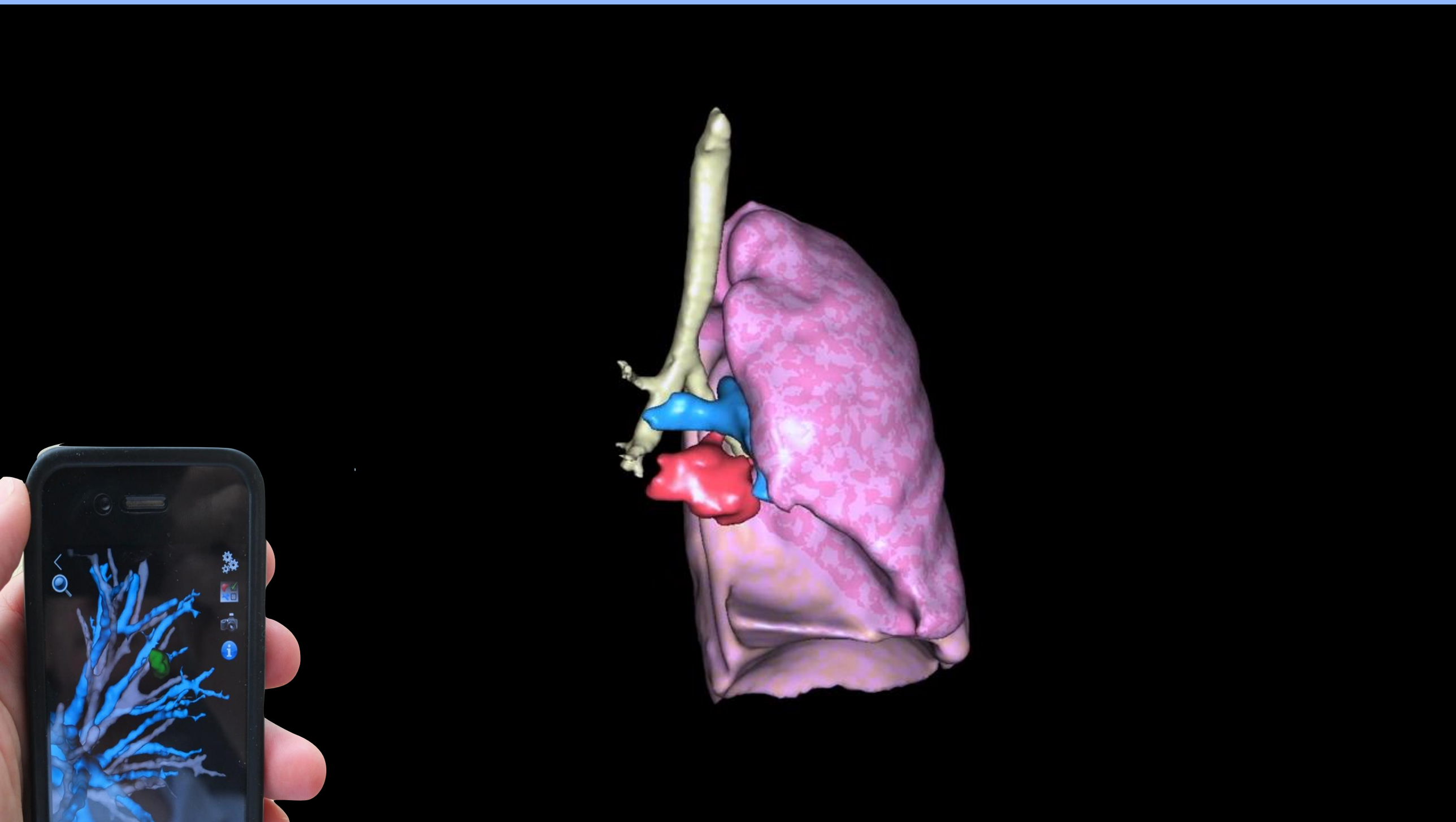
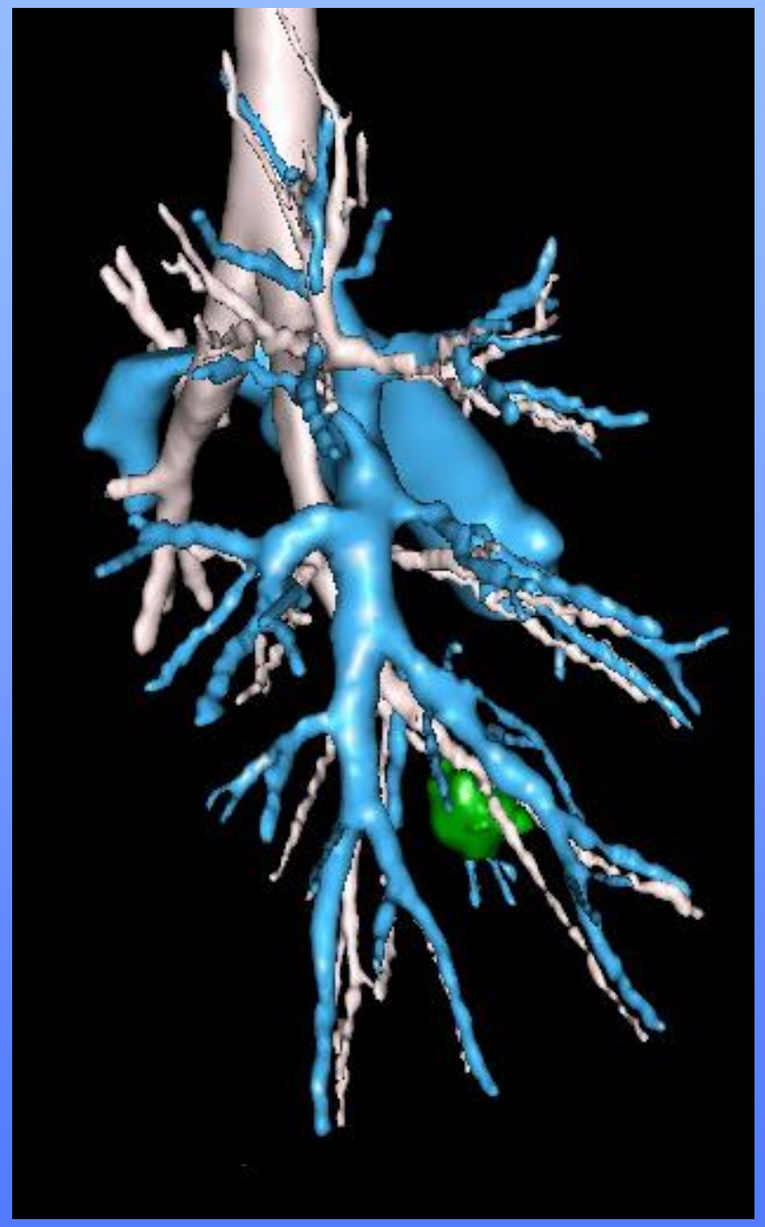
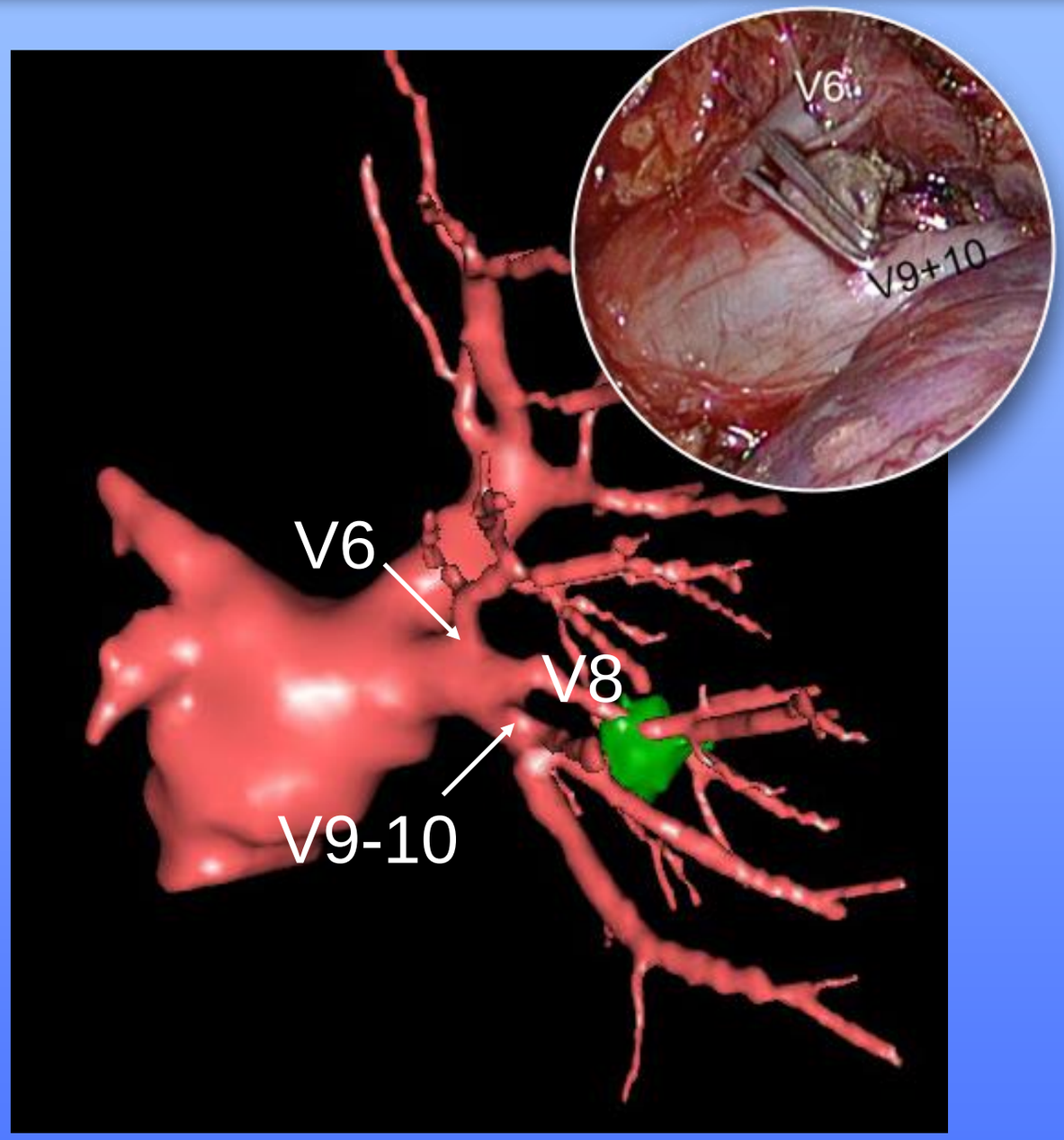
3D reconstructions



Practical application

Single lung metastasis in right S8





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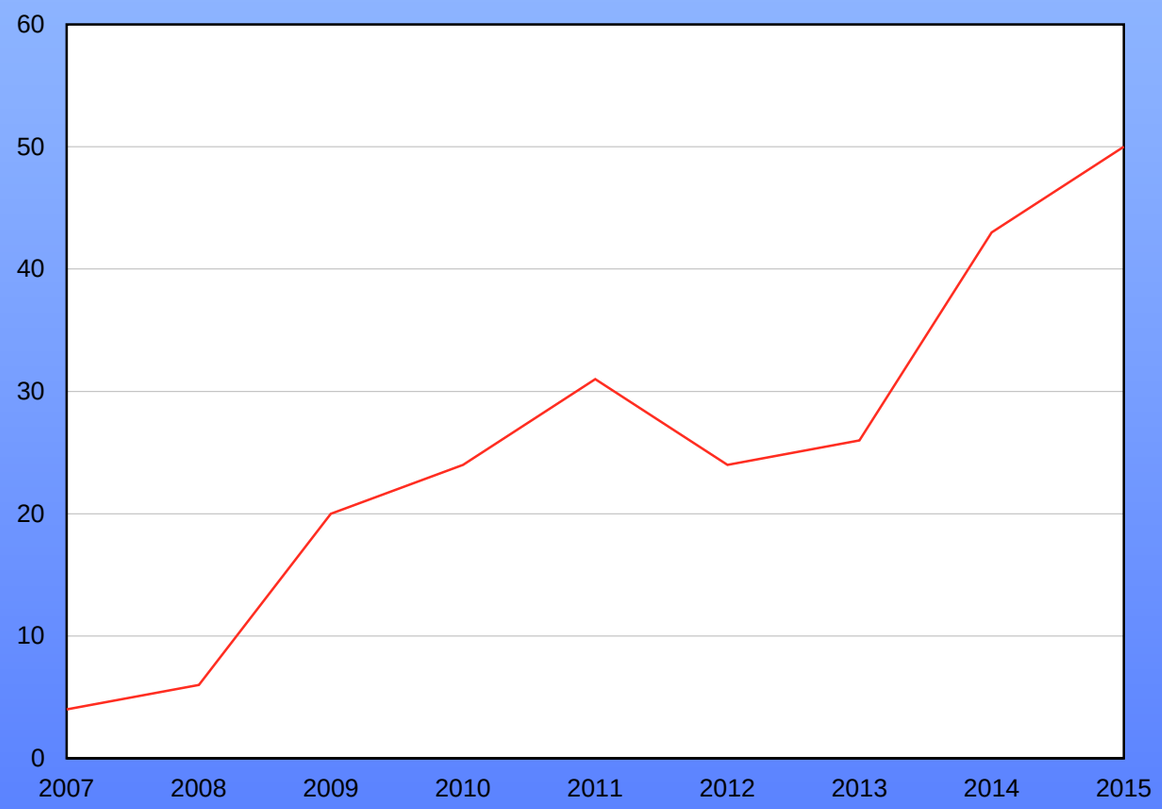
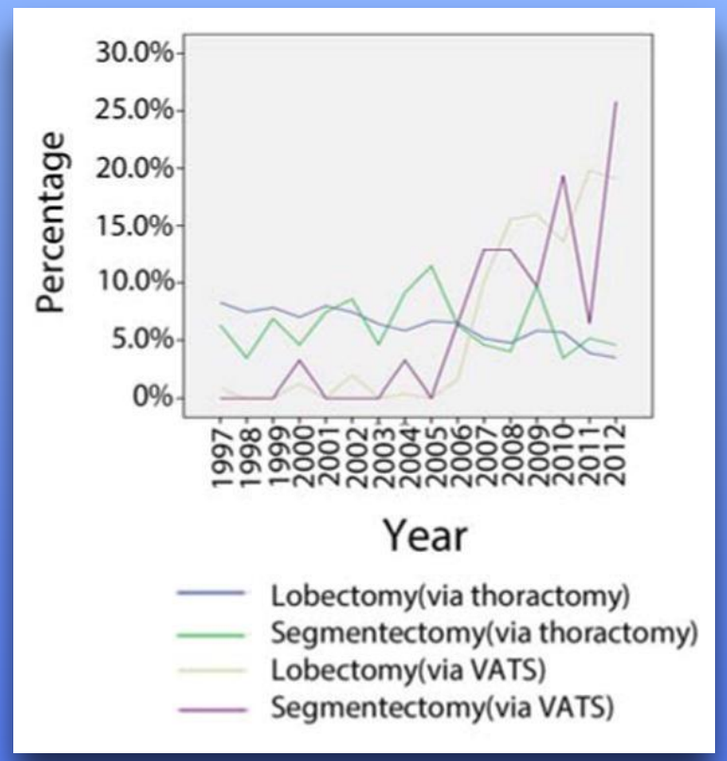
Our experience

N = 255





The Mayo Clinic trend
J Thorac Cardiovasc Surg 2014; 148:1186-1192

Our series

N = 255

	N
NSCLC	156
Metastasis	51
Benign	48

	N
Male	113
Female	142
Age	63 (18-86)

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Our series

Right Lung

Segments	N
S1+2	52
S3	5
S6	23
S7+8	2
9+10	5
Basilar	25

Multiple	N
S3 + ML	1

Left Lung

Segments	N
S1+2	19
Lingula	17
Lingula sparing	35
S6	34
S8	1
9+10	3
Basilar	25

Multiple	N
S2 + S6	1
S3 + Lingula	1

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Morbidity:
Results (N=255)

Conversion rate:
3.1%

Conversion	N
Hemorrhage	4
Technical difficulties	3
Nodule not found	1

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Conversion rate
Other series

Series	N	Conversion
Shiraishi	34	0 %
Okada	52	NS
Atkins	48	0 %
Oizumi	29	0 %
Yamada	9	0 %
Schuchert	104	NS
Watanabe	41	0 %
Yamashita	90	4.8%
Witte	56	30 %
IMM	255	3.1 %

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Results

Surgery	N
Op. time	158 (51-243)
Op. Blood loss	88 (0-450)
Extended resection	7
Reoperation	3

Hemorrhage	1
Lingular ischemia	2

Planned	Final	Reason
Right S1+2	RUL	Vascular tear
Right S1+2	RUL	Resection margin
Lingula sparing trisegmentectomy	LUL	Resection margin
S9+10	Basilar resection	Resection margin
S7+8	Basilar resection	Nodule not found
S8	LLL	Positive LN
S8	LLL	Resection margin

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Issues

1. Outcome of segmentectomies
2. Outcome compared to the gold standard (Lobectomy)
3. Does technique impact on outcome (intersegmental plane)
4. Can we do better ?

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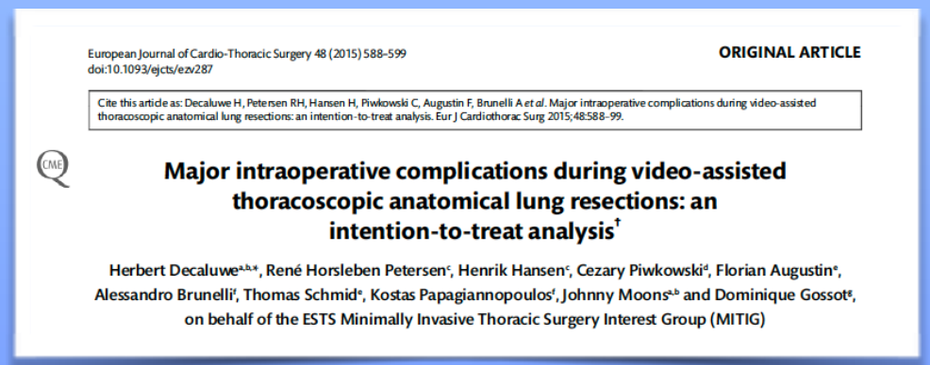
1 - postoperative outcome

Morbidity:
Our series (N=255)

Postoperative complications

Postop. complication	N
Segmental ischemia requiring reoperation	2
Prolonged air leak (> 5 days)	8
Pneumothorax requiring chest drainage	2
Sputum retention requiring bronchoscopy	1
Pneumonia	6
Pulmonary oedema	1
Pulmonary embolism	2
Arythmia	3
Neurologic disorder	1


European Journal of Cardio-Thoracic Surgery 48 (2015) 588–599
doi:10.1093/ejcts/ezv287

ORIGINAL ARTICLE

Cite this article as: Decaluwe H, Petersen RH, Hansen H, Piwkowski C, Augustin F, Brunelli A *et al*. Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections: an intention-to-treat analysis. Eur J Cardiothorac Surg 2015;48:588–99.

Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections: an intention-to-treat analysis†

Herbert Decaluwe[a,b,*], René Horsleben Petersen[c], Henrik Hansen[c], Cezary Piwkowski[d], Florian Augustin[e], Alessandro Brunelli[f], Thomas Schmid[e], Kostas Papagiannopoulos[f], Johnny Moons[a,b] and Dominique Gossot[g], on behalf of the ESTS Minimally Invasive Thoracic Surgery Interest Group (MITIG)

- Drainage: 3.1 ± 1.9
- Stay: 5.6 ± 2.4

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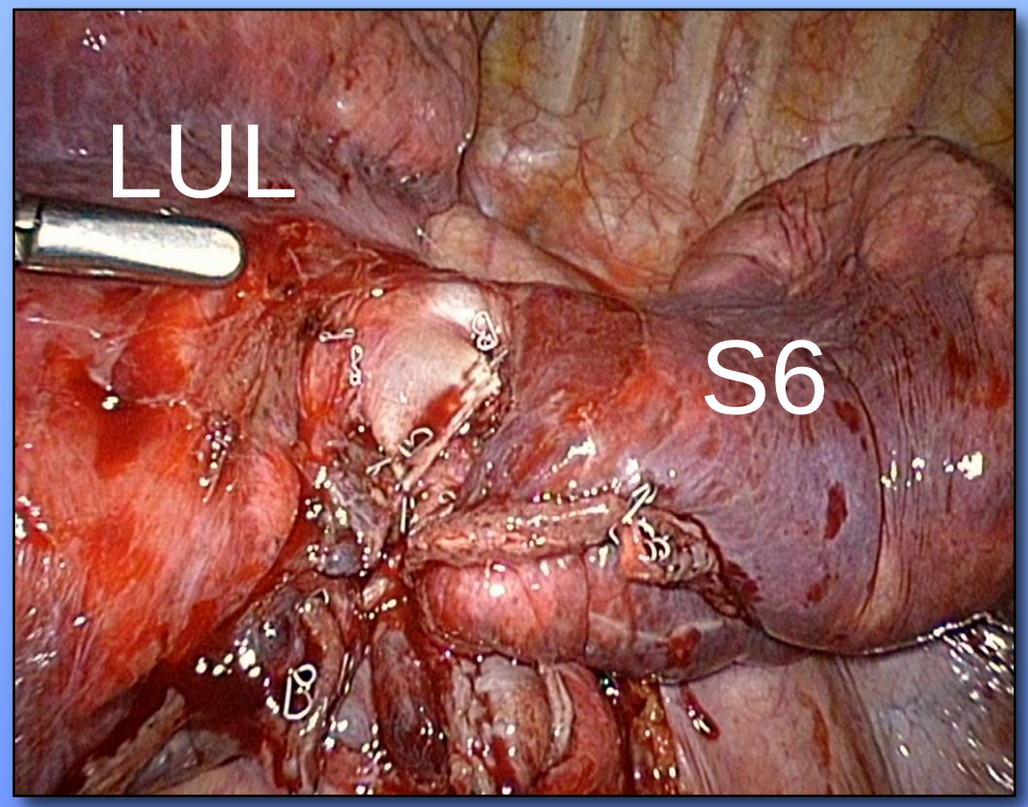
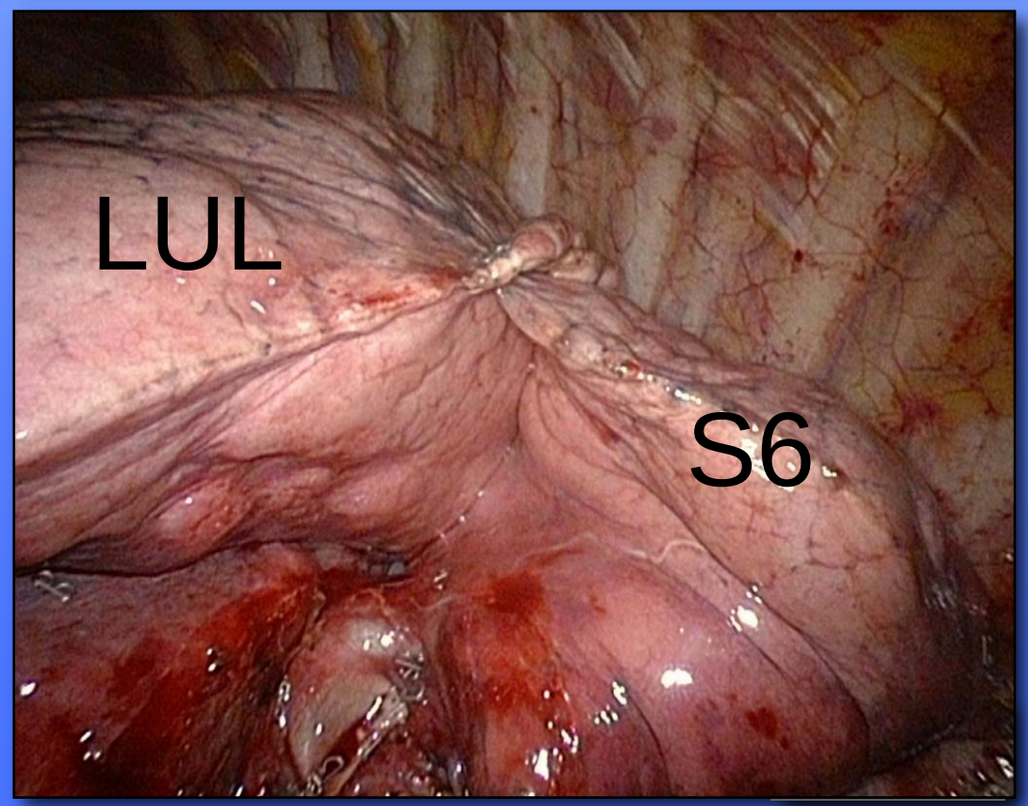
Morbidity:
Our series (N=255)

Postop. complication	N
Segmental ischemia requiring reoperation	2
Prolonged air leak (> 5 days)	8
Pneumothorax requiring chest drainage	2
Sputum retention requiring bronchoscopy	1
Pneumonia	6
Pulmonary oedema	1
Pulmonary embolism	2
Arythmia	3
Neurologic disorder	1

12%





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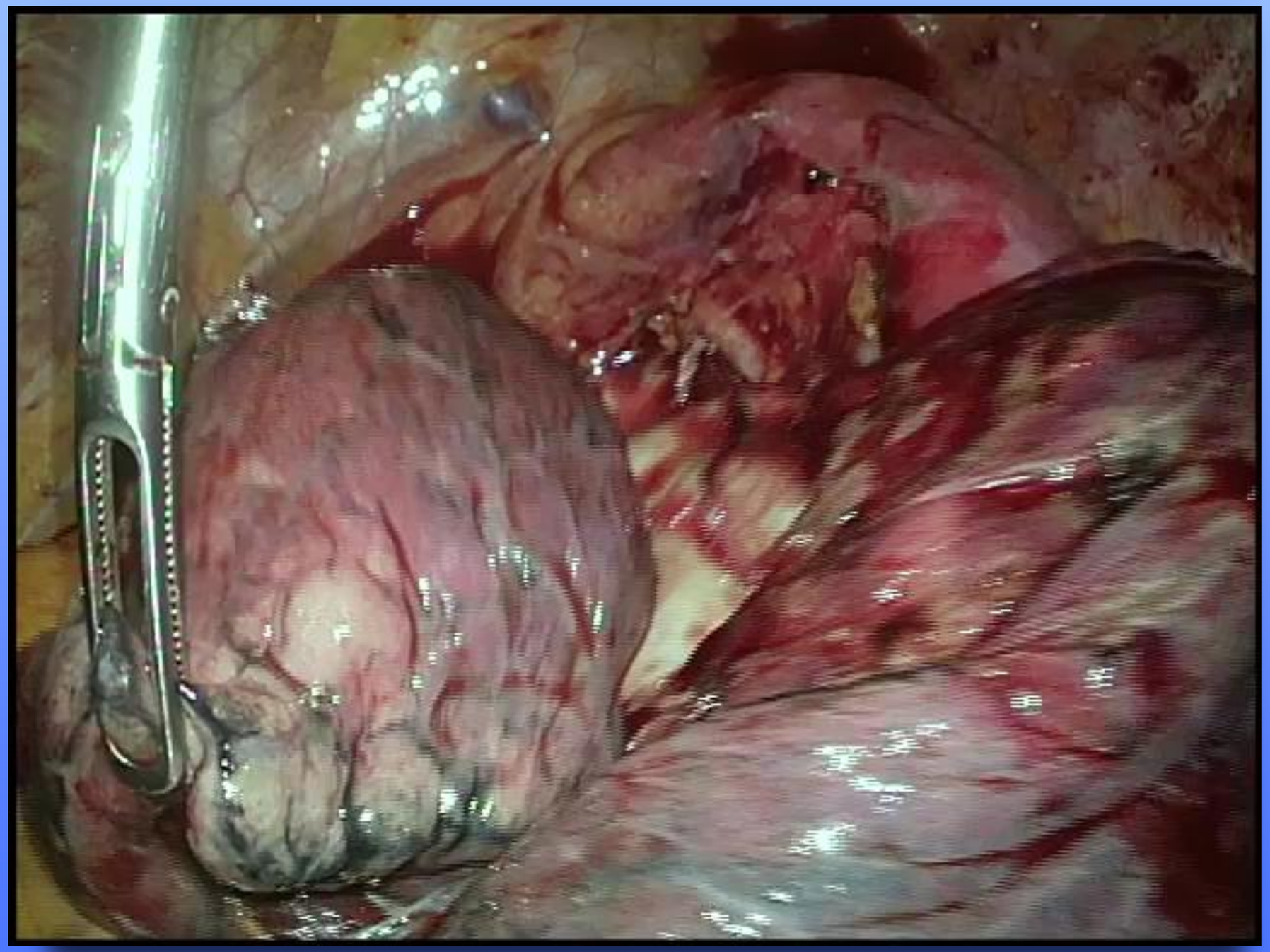
Prevention of segmental twisting



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Morbidity:
Other series

Series	N	Morbidity	Drainage	Stay
Shiraishi	34	11.7%	4.5	12.7
Okada	52	13.5%	3	NS
Atkins	48	31.3%	3.5	4.3
Oizumi	29	10 %	1	NS
Yamada	9	11 %	1.6	7.6
Schuchert	104	26 %	NS	5
Watanabe	41	10 %	3	NS
Yamashita	90	19 %	4.8 ± 3.4	12.2 ± 8.2
Witte	56	35 %	7	9
IMM	255	12 %	3.1 ± 1.9	5.6 ± 2.4

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2 - postoperative outcome

(compared to lobectomies)

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Comparison of thoracoscopic segmentectomy and thoracoscopic lobectomy on the patients with non-small cell lung cancer: a propensity score matching study†

Yoohwa Hwang[a], Chang Hyun Kang[a,*], Hye-Seon Kim[b], Jae Hyun Jeon[c], In Kyu Park[a] and Young Tae Kim[a]

Department of Thoracic and Cardiovascular Surgery, Biomedical Research Institute, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Korea
Department of Thoracic and Cardiovascular Surgery, Seoul National University Bundang Hospital, Gyeonggi-do, Korea
Department of Thoracic and Cardiovascular Surgery, National Cancer Center, Gyeonggi-do, Korea

Variable	Sublobar n=94	Lobectomy n=94	p-value
Complications	11 %	17.2 %	0.1
Hospital Stay	6.2 +/- 5.2	7.1+/- 7.1	0.31

EJCTS 2015; 48:273-278

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Factors associated with preserved pulmonary function in non-small-cell lung cancer patients after video-assisted thoracic surgery

Se Joong Kim[a], Soyeon Ahn[b], Yeon Joo Lee[a], Jong Sun Park[a], Young-Jae Cho[a], Sukki Cho[c], Ho Il Yoon[a], Kwhanmien Kim[c], Jae Ho Lee[a], Sanghoon Jheon[c] and Choon-Taek Lee[a,*]

EJCTS 2016; 49:1084-1090

FEV-1 and DLCO better preserved

- VATS segmentectomy > VATS lobectomy
- RUL or ML > RLL, LUL and LLL

3 - postoperative outcome

compared to open segmentectomies

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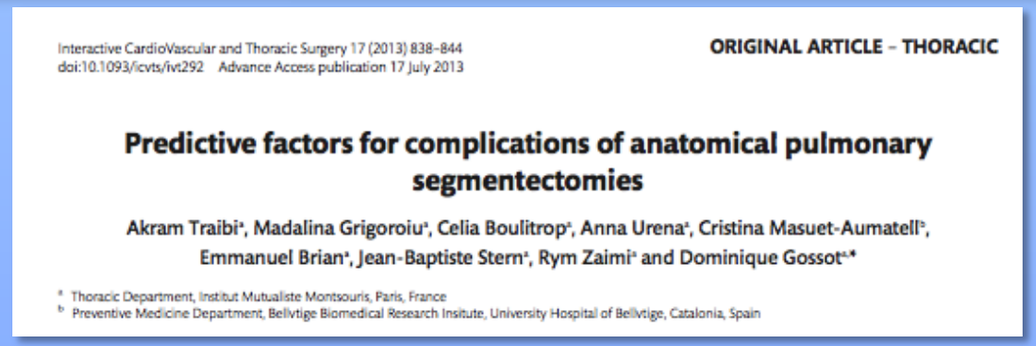
Comparison with open segmentectomies



Interactive CardioVascular and Thoracic Surgery 17 (2013) 838–844
doi:10.1093/icvts/ivt292 Advance Access publication 17 July 2013

ORIGINAL ARTICLE – THORACIC

Predictive factors for complications of anatomical pulmonary segmentectomies

Akram Traibi[a], Madalina Grigoroiu[a], Celia Boulitrop[a], Anna Urena[a], Cristina Masuet-Aumatell[b], Emmanuel Brian[a], Jean-Baptiste Stern[a], Rym Zaimi[a] and Dominique Gossot[a,*]

[a] Thoracic Department, Institut Mutualiste Montsouris, Paris, France
[b] Preventive Medicine Department, Bellvtige Biomedical Research Insitute, University Hospital of Bellvtige, Catalonia, Spain

- 2007-2011
- N = 228 segmentectomies / 221 patients
- Age: 61 years (18 - 86 ans)
- Mean FEV1: 86% (30 patients < 60%)

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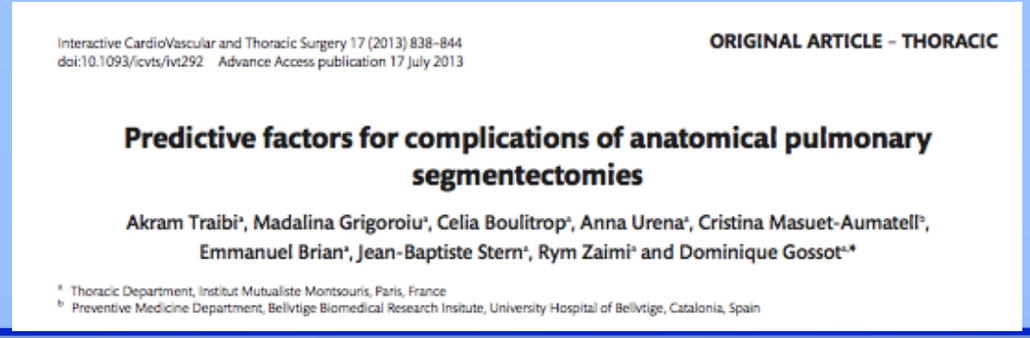

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[a] Thoracic Department, Institut Mutualiste Montsouris, Paris, France
[b] Preventive Medicine Department, Bellvtige Biomedical Research Insitute, University Hospital of Bellvtige, Catalonia, Spain

- Mortality at 3 months: 3 patients (1.32%)
- Overall complication rate: 34%
- Serious complications: 6%
  - Reoperation
  - Unplanned ICU stay

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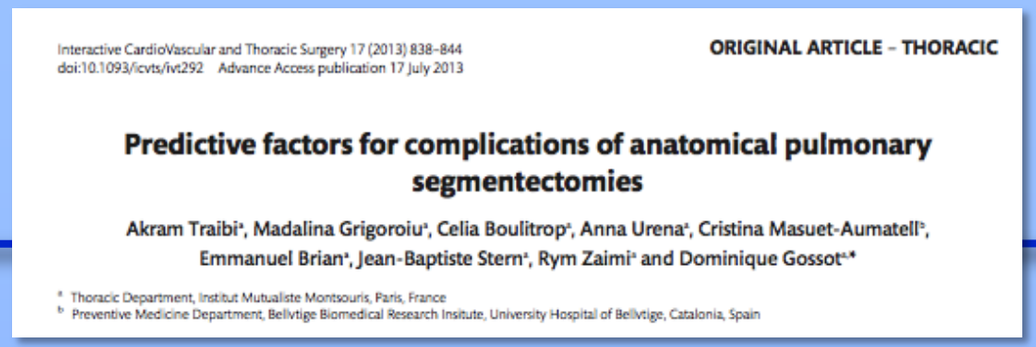

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[a] Thoracic Department, Institut Mutualiste Montsouris, Paris, France
[b] Preventive Medicine Department, Bellvtige Biomedical Research Insitute, University Hospital of Bellvtige, Catalonia, Spain

According to the approach

	Thoracotomy	Thoracoscopy	*p* Value [a]
Overall complications rate	n= 61 (42 %)	n = 16 (19.5%)	p < 0.001
Mean postoperative stay	10.5 j	6.6 j	p = 0.008
Mean drainage duration	5.65	3.51	p= 0.001

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Complications

Multivariate analysis

	Adjusted Odds Ratio	*p* Value [a]
Gender (Male)	2,04	0,01
FEV-1 (≤ 60%)	0,982	< 0.001
Approach (Thoracoscopy)	0,038	< 0.001

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Complications

225 segmentectomies for stage 1 NSCLC

- 104 thoracoscopy: 15.4%
- 121 thoracotomy: 29.8%

Schuchert M et al. J Thorac Cardiovascsurg 2009; 138: 1318-1325

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Comparative intention-to-treat analysis of the video-assisted thoracoscopic surgery approach to pulmonary segmentectomy for lung carcinoma[‡]

Biruta Witte[a,b,1], Christian Stenz[a,1], Christian Friedrich Vahl[c] and Martin Huertgen[a,*]

[a] Department of Thoracic Surgery, Katholisches Klinikum Koblenz-Montabaur, Koblenz, Germany
[b] Department of Thoracic Surgery, Justus Liebig University, Giessen, Germany
[c] Department of Cardiovascular and Thoracic Surgery, Johannes Gutenberg-Universität, Mainz, Germany

Interact CardioVasc and Thorac Surg 2015;21:276-283

Variable	Open n=44	VATS n=56	p-value
Complications	50 %	35 %	1.00
Chest tube	7 (IQR:5-9)	7 (IQR:4-10)	0.8
Hospital Stay	12 (IQR:9-16)	9 (IQR:7.7-14)	1.00

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Comparative Outcomes of Elderly Stage I Lung Cancer Patients Treated with Segmentectomy via Video-Assisted Thoracoscopic Surgery versus Open Resection

Cardinale B. Smith, MD, MSCR, Minal Kale, MD,† Grace Mhango, MPH,† Alfred I. Neugut, MD, PhD,‡§ Dawn L. Hershman, MD, MS,‡§ John P. Mandeli, PhD,‖ and Juan P. Wisnivesky, MD, DrPH†¶*

J Thorac Oncol 2014; 9:383-389

Outcome	Open n=424	VATS n=153
Any complication	39 %	26 %
Extended length of stay	16 %	7 %
ICU	71 %	31 %

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Video-Assisted Thoracoscopic Surgery Is a Safe and Effective Alternative to Thoracotomy for Anatomical Segmentectomy in Patients With Clinical Stage I Non-Small Cell Lung Cancer

Presented at the Fifty-first Annual Meeting of The Society of Thoracic Surgeons, San Diego, CA, Jan 24–28, 2015.

Galal Ghaly, MD*, Mohamed Kamel, MD, Abu Nasar, MS, Subroto Paul, MD, Paul C. Lee, MD, Jeffrey L. Port, MD, Brendon M. Stiles, MD*, Nasser K. Altorki, MD

Ann Thorac Surg 2016;101:465-472

Variable	Open n=91	VATS n=102	p-value
Pulmonary Complications	27 %	13 %	0.02
Hospital Stay	5	4	1

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Is FEV-1 still predictive of complications ?

- 70 resections with FEV1 40-60%
- Postoperative pneumonia:

Thoracoscopy group: 4.3%

Thoracotomy group: 21.7%

Cachera S et al. J Thorac Cardiovasc Surg 2011; 141: 459-462

- 340 resections with FEV1 < 60%
- FEV1 as predictive factor of complication only for patients operated on via thoracotomy

Berry M et al. Ann Thorac Surg 2010; 89: 1044-1052

4 - Impact of technique on postoperative outcome

Intersegmental plane

Series	Division of intersegmental plane
Shiraishi	Ultrasonic shears
Okada	Electrocautery + fibrin sealant
Atkins	Stapling
Oizumi	Stapling
Schuchert	Stapling
Watanabe	Electrocautery + Stapling + fibrin sealant
Shapiro	Stapling
Leshnover	Stapling
Yamashita	Stapling
IMM	Stapling

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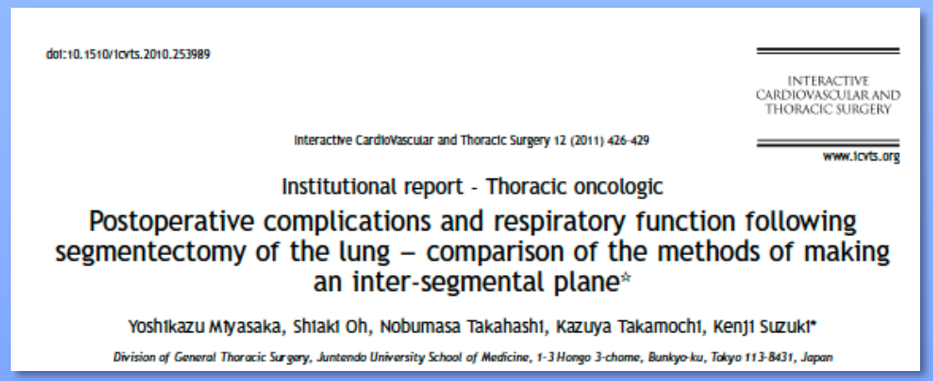
No stapling: a step backward ?


doi:10.1510/icvts.2010.253989

INTERACTIVE CARDIOVASCULAR AND THORACIC SURGERY

Interactive CardioVascular and Thoracic Surgery 12 (2011) 426-429

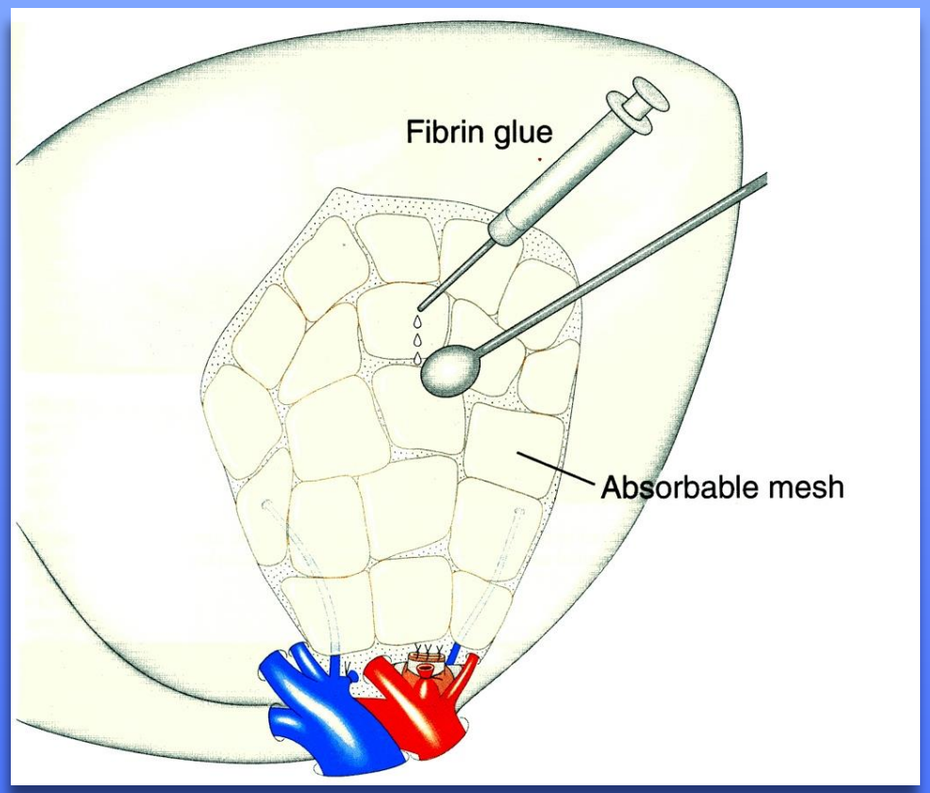
www.icvts.org

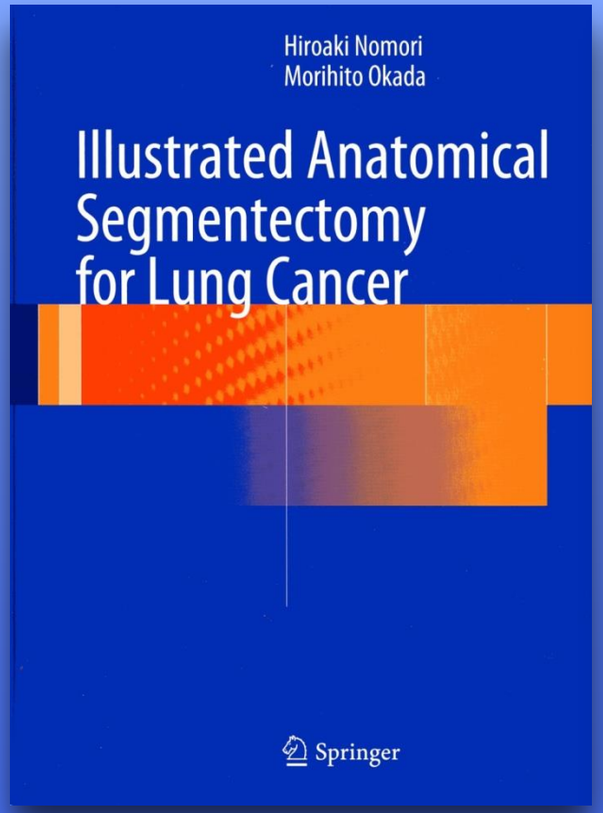
Institutional report - Thoracic oncologic

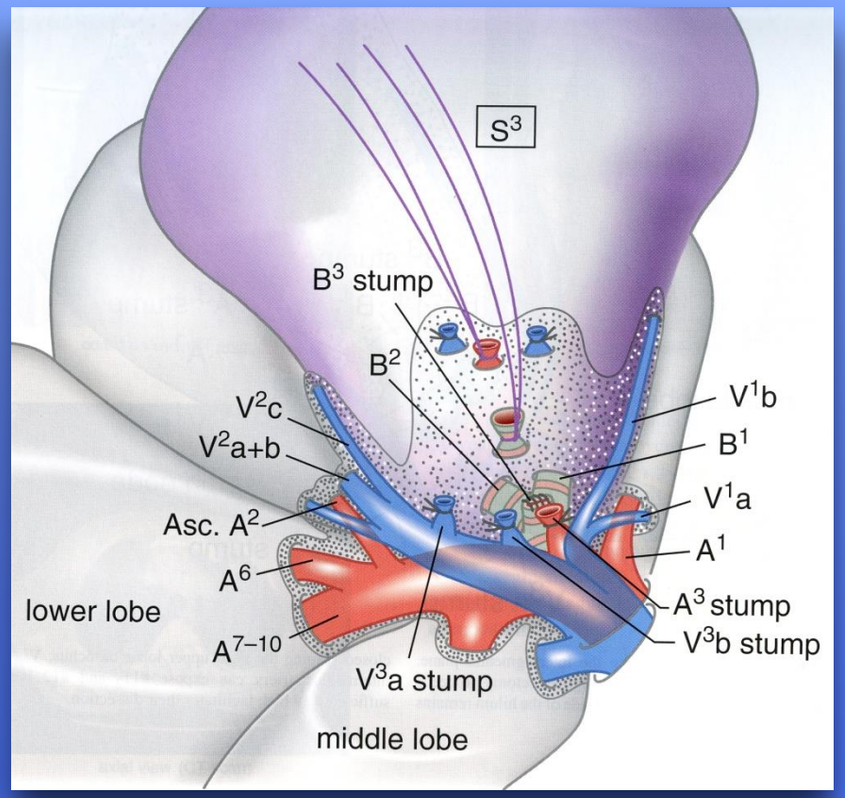
Postoperative complications and respiratory function following segmentectomy of the lung – comparison of the methods of making an inter-segmental plane☆

Yoshikazu Miyasaka, Shiaki Oh, Nobumasa Takahashi, Kazuya Takamochi, Kenji Suzuki*

Division of General Thoracic Surgery, Juntendo University School of Medicine, 1-3 Hongo 3-chome, Bunkyo-ku, Tokyo 113-8431, Japan







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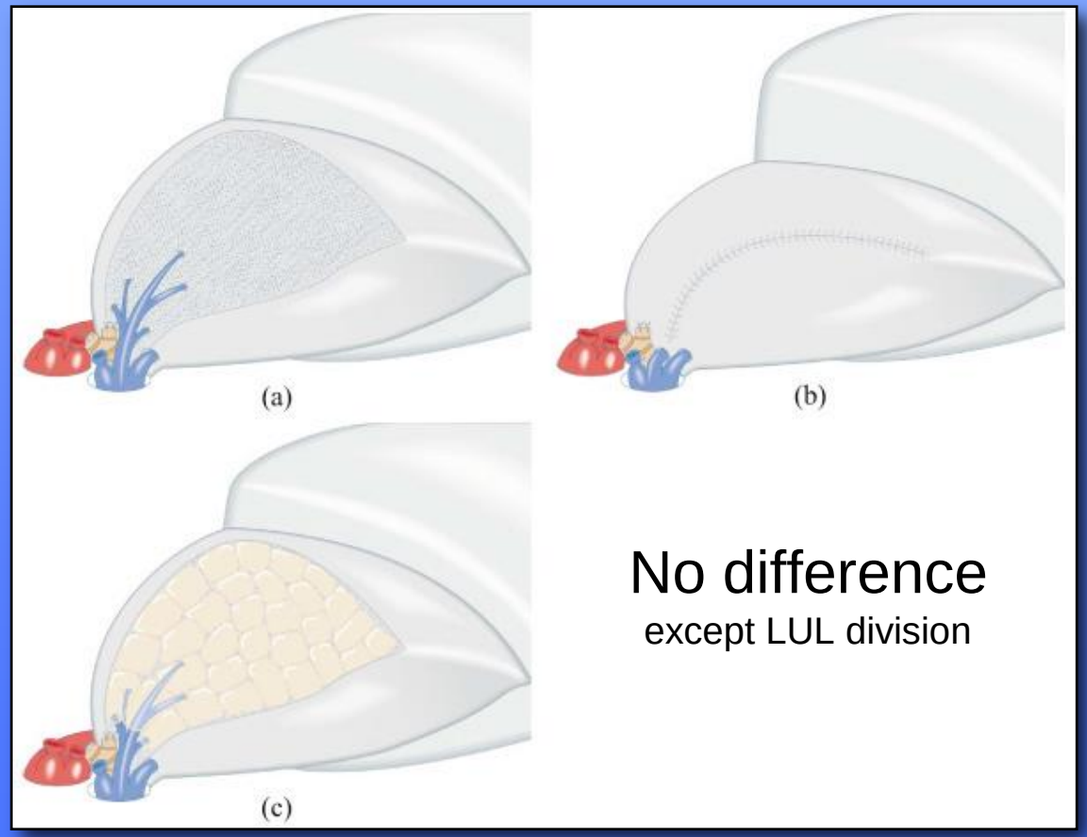
Intersegmental plane comparison

Comparison of postoperative pulmonary function and air leakage between pleural closure vs. mesh-cover for intersegmental plane in segmentectomy

Kentaro Yoshimoto[1†], Hiroaki Nomori[1,2*†], Takeshi Mori[1†], Yasuomi Ohba[1†], Kenji Shiraishi[1†] and Koei Ikeda[1†]



No difference
except LUL division

Yoshimoto K, et al. Journal of cardiothoracic surgery 2011;6:61

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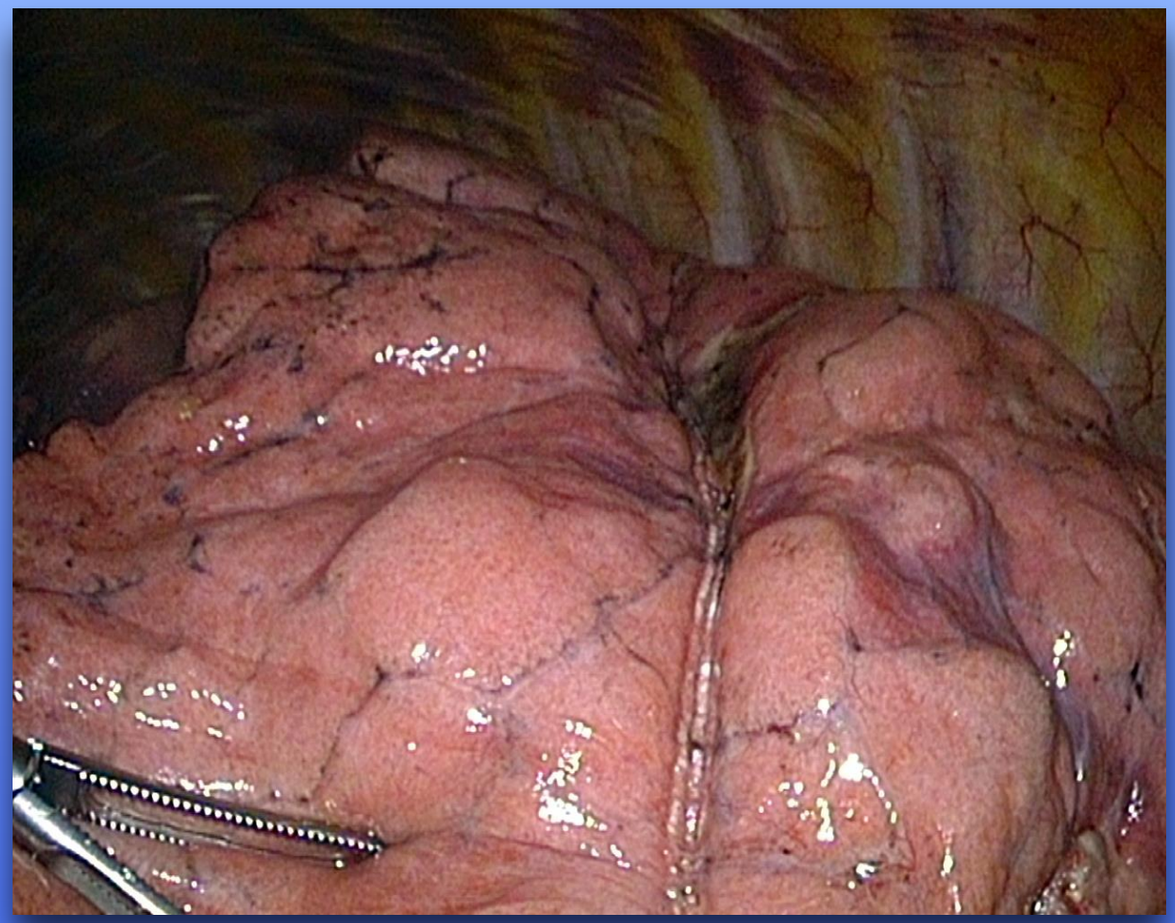
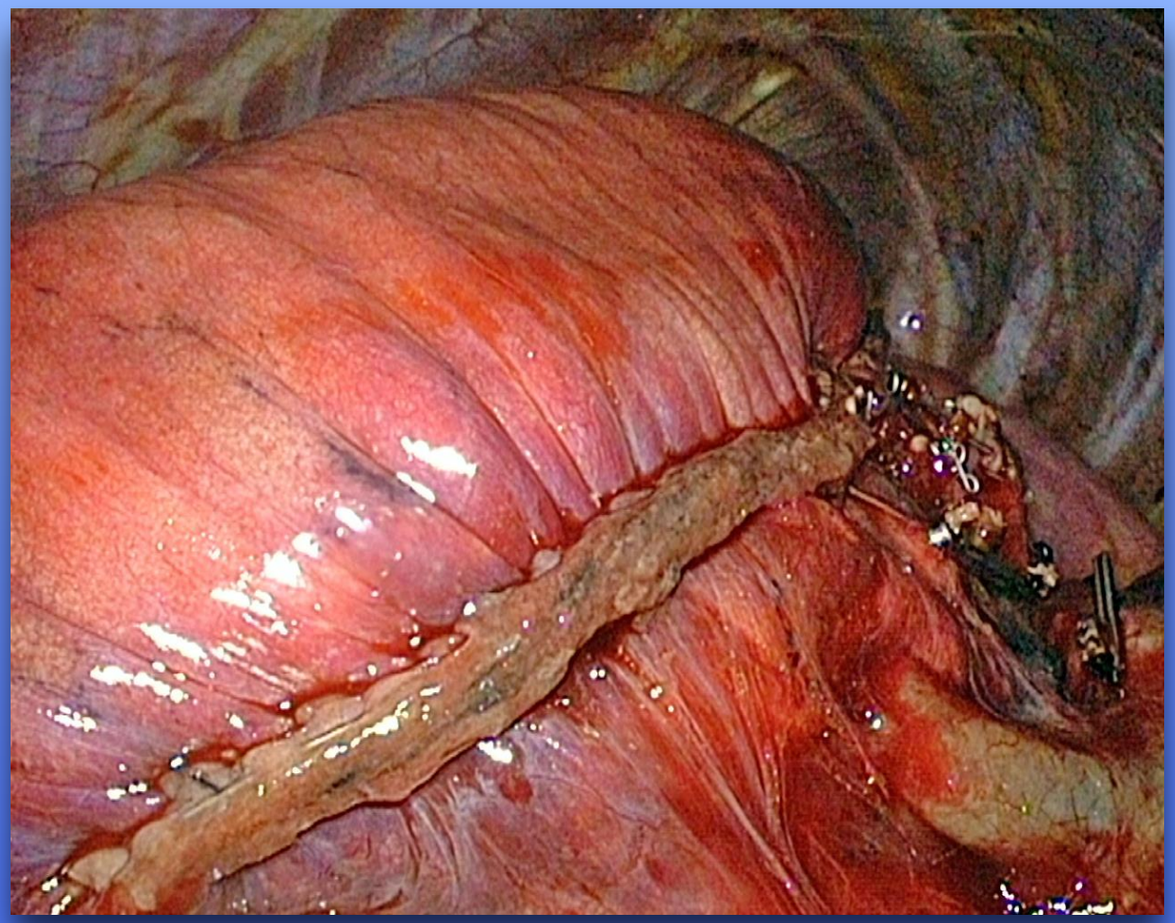
Technique

Compression + Stapling





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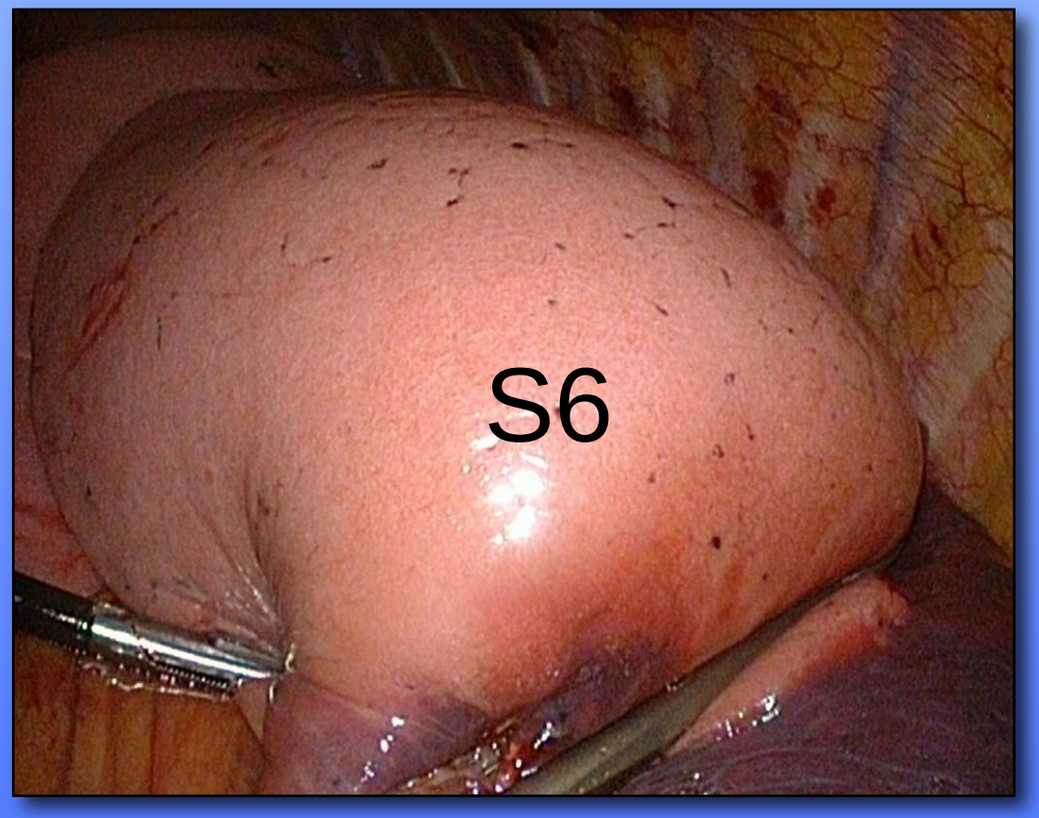
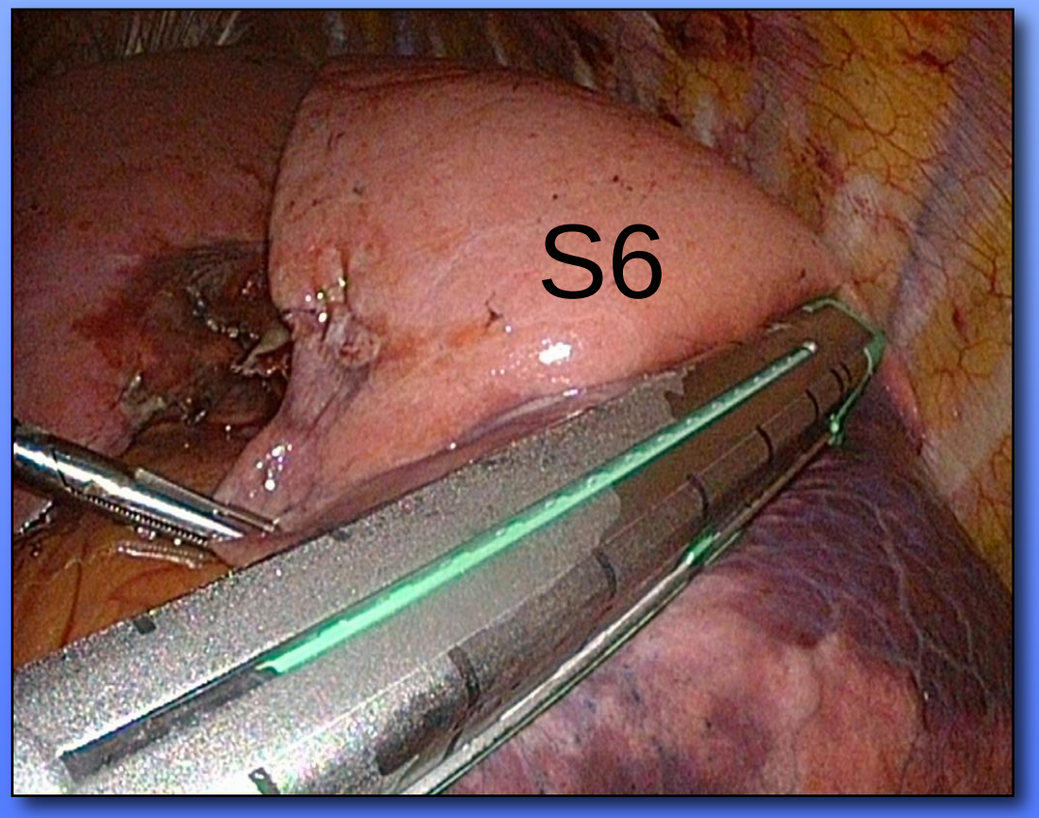
Technique

Compression + Stapling





Left basilar segmentectomy

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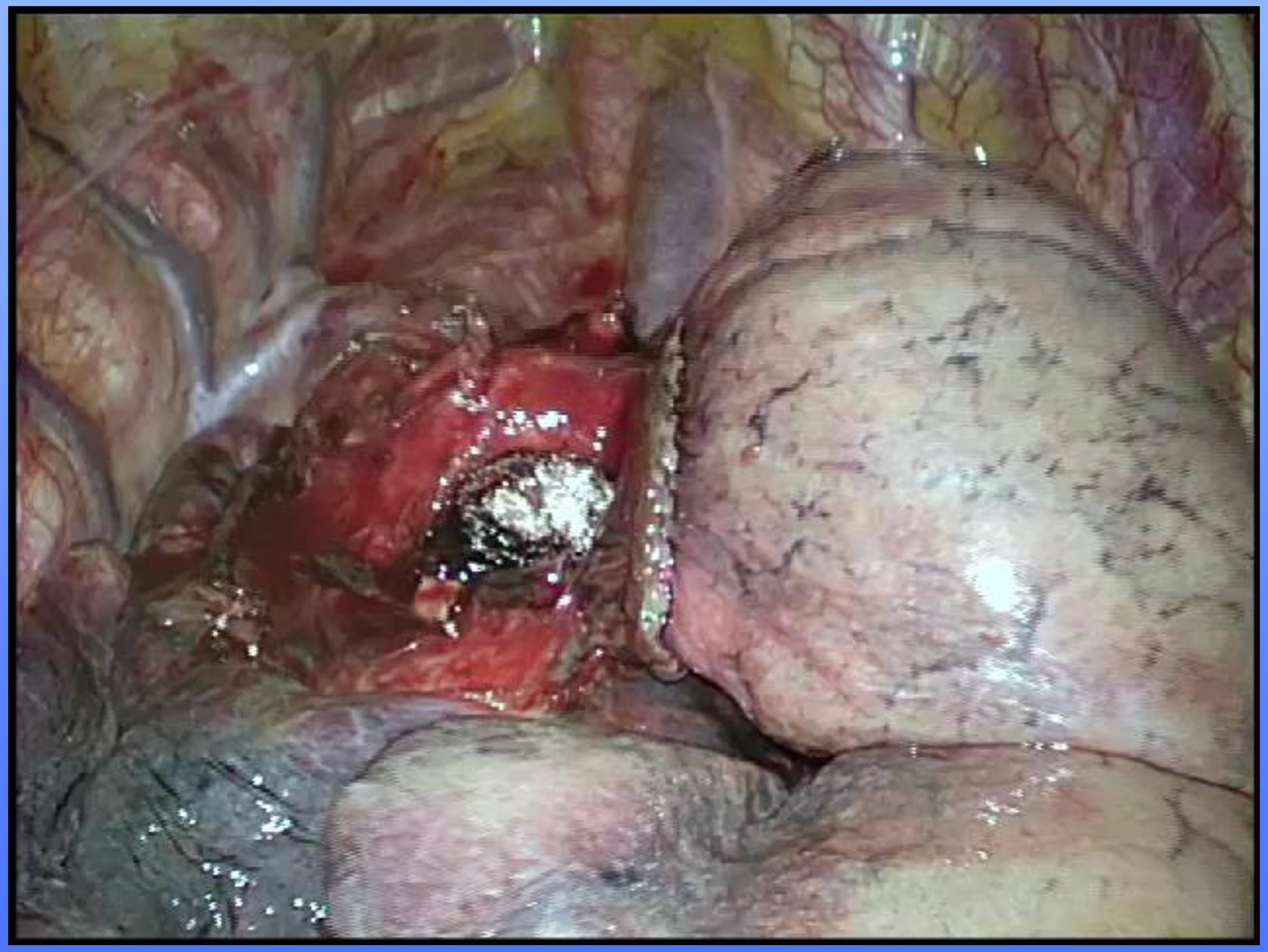
Is stapling an issue ?

Right S^{1+2} segmentectomy



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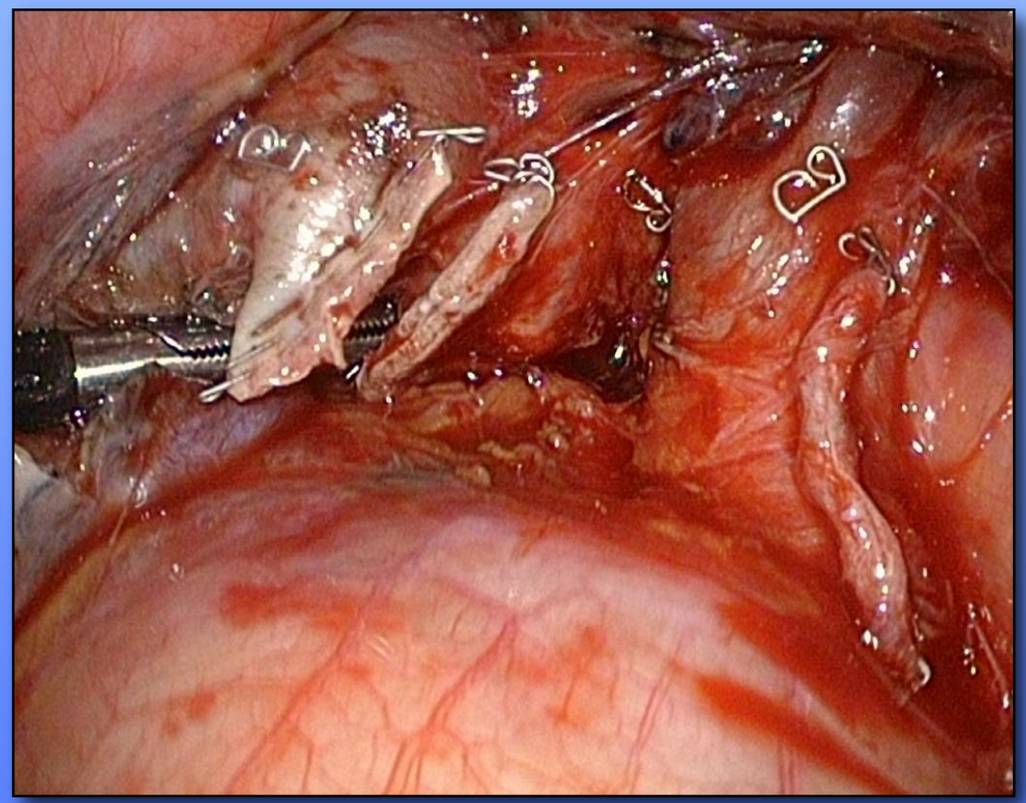
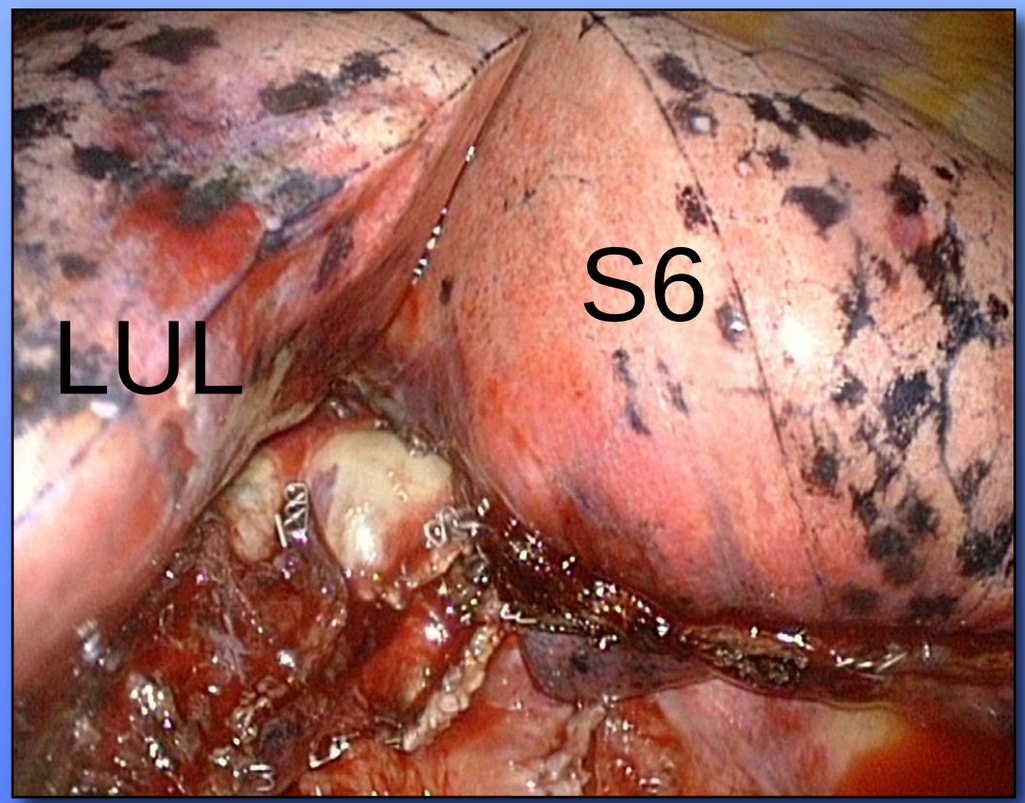
Example

Left basilar segmentectomy





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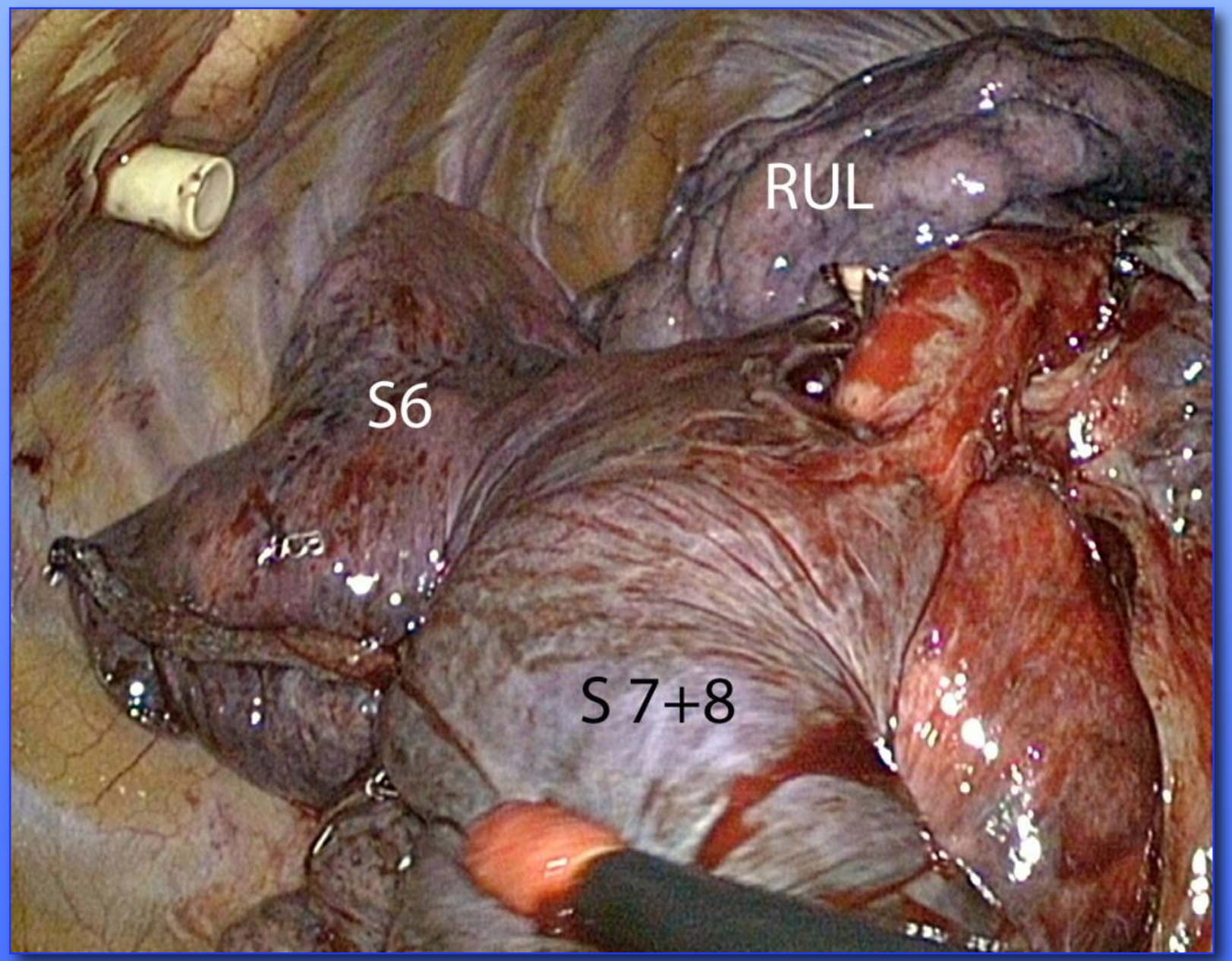
Example

Right S9+10 segmentectomy



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Evaluation of lung reexpansion

- N = 165
- Age : 63 (18-86), 113 patients > 70y
- All chest X-Rays at discharge and 1 month
- Independent observer

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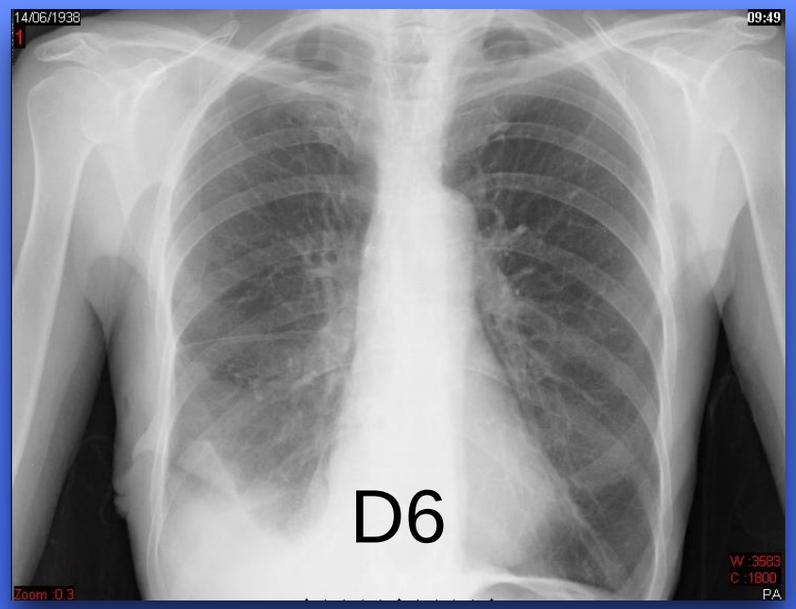
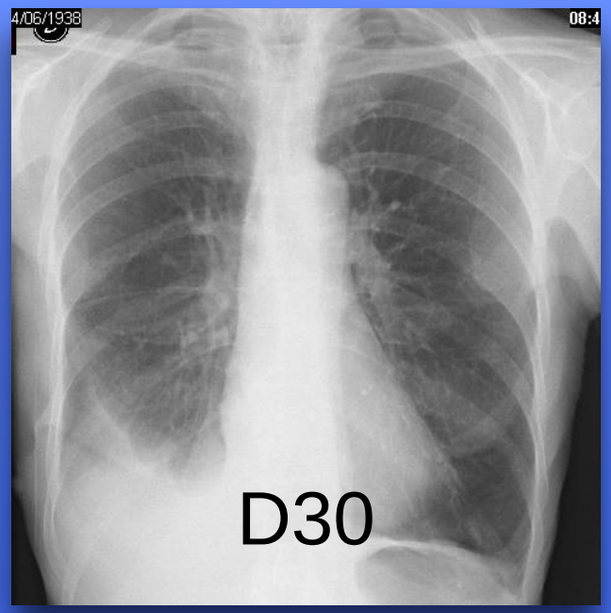
Evaluation of lung reexpansion

	Incomplete reexpansion	
Control chest X-ray	n	%
At discharge	12	7.4
At 1-month consultation	4	2.8





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Evaluation of lung reexpansion

	Upper segment		Lower segment		P-value
Control chest X-ray	**n**	**%**	**n**	**%**	
At discharge	10	6.1	2	1.2	0.01
At 1-month follow up	4	2.8	0	0	0.04

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Cautery vs stapling: input on PAL

- Our series : 165 patients
  - PAL: 7 (4.2%)
  - Reoperation: 0
- Miyasaka et al: 49 patients
  - Cautery (31) vs Stapling (18)
  - PAL: 4 (8.2%), <u>all in cautery group</u> (p=0.005)
  - Reoperation: 3

Miyasaka Y et al. Interact Cardiovasc Thorac Surg. 2011;12:426-9

- Ohtsuka et al: 147 patients
  - Cautery (22) *vs* Cautery+Stapling (125)
  - PAL: 3/22 (14%) vs 1/125 (4%) (p=0.025)

Ohtsuka T et al. J Cardiothoracic Surg. 2012;7:42-6

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Intersegmental plane
Conclusion

- Stapling probably impairs reventilation
- Clinical consequences are minimal
- Safety

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Conclusion (1)

How reducing morbidity ?

- Better selecting our patients
- Minimizing trauma
- Enhancing precision of our procedures
  - 3D reconstructions
  - Navigation

Some examples…

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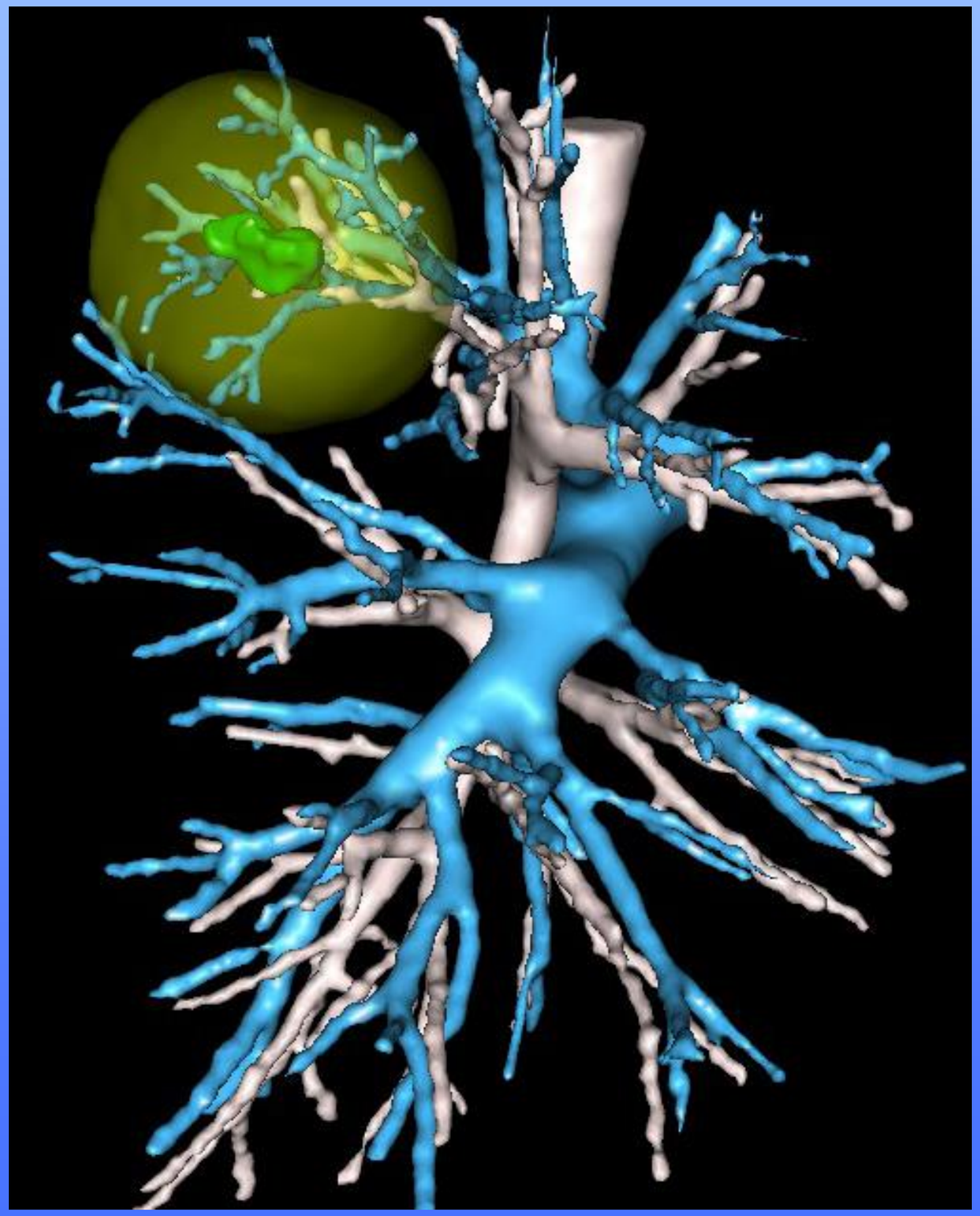
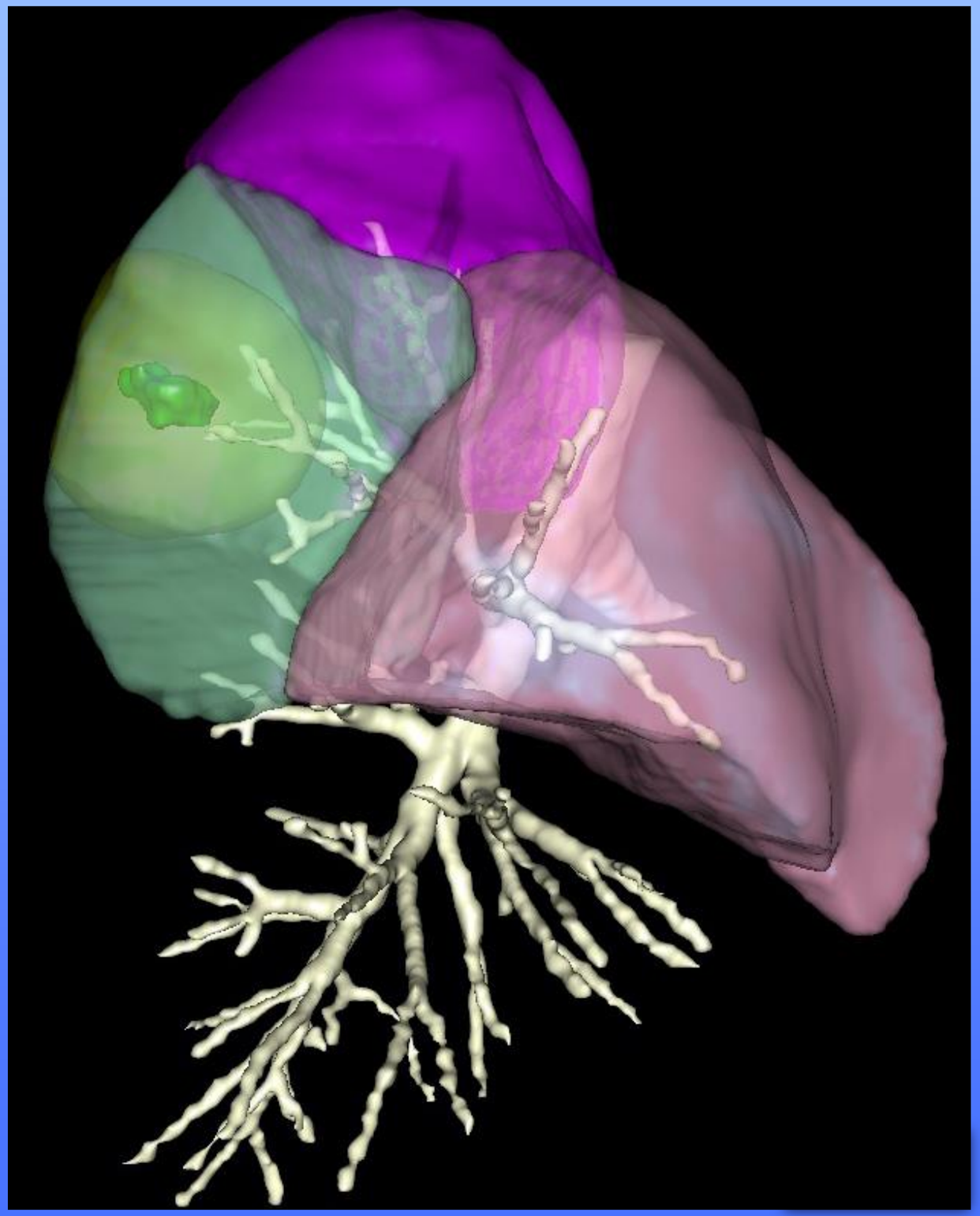
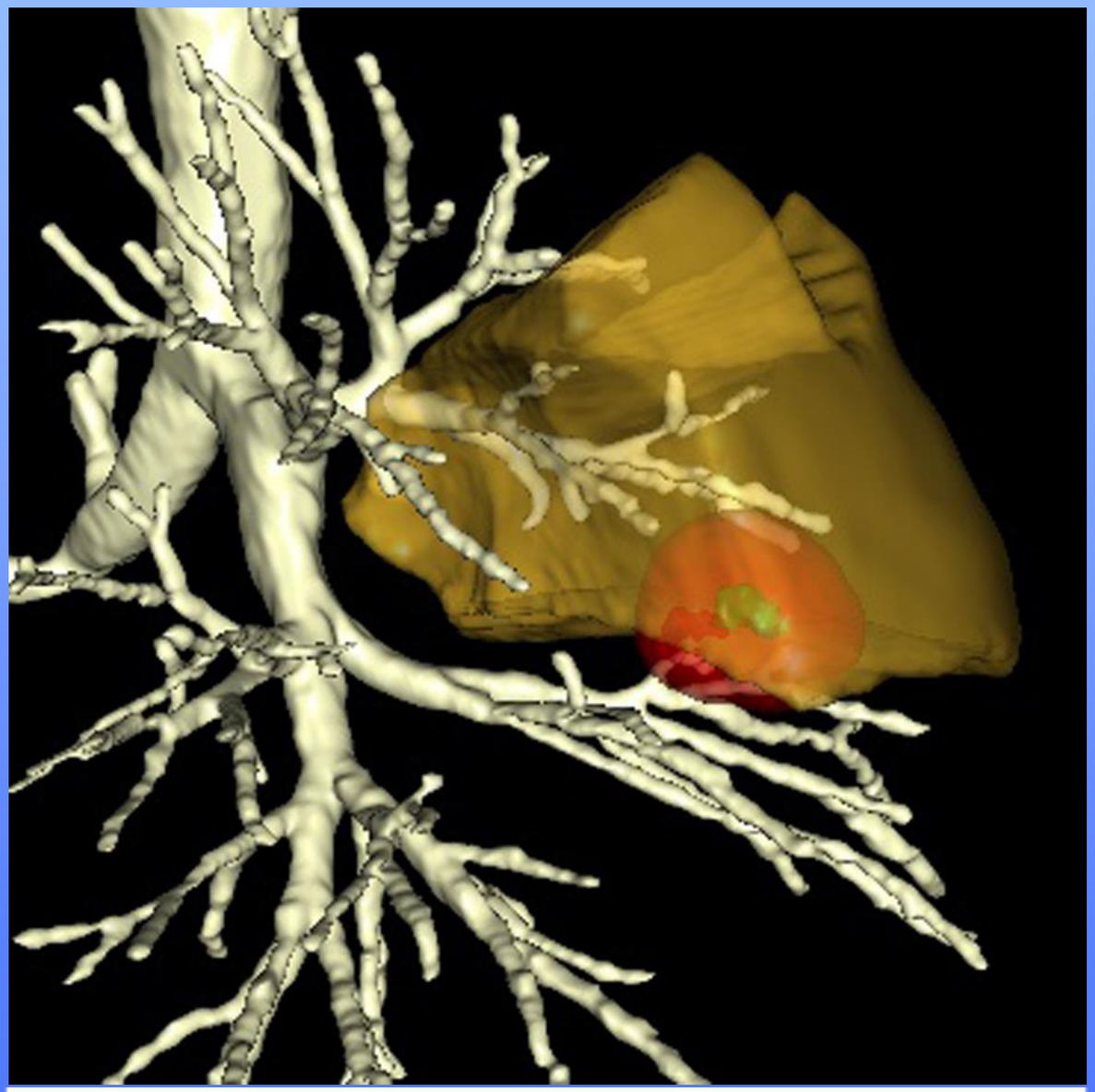
Example 1

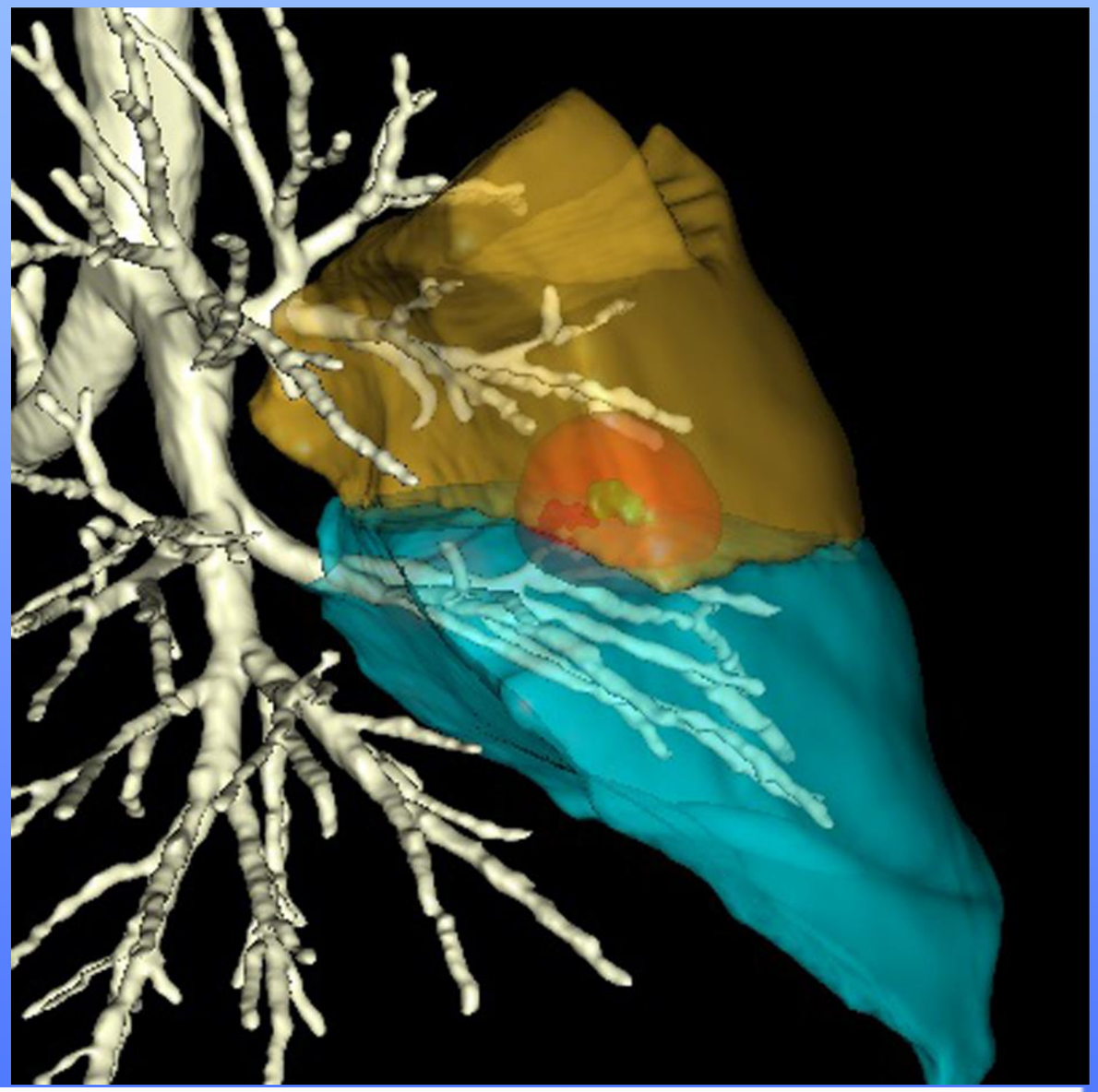




Example 2



Planned procedure: right S^3



Performed procedure: right S^3 + ML

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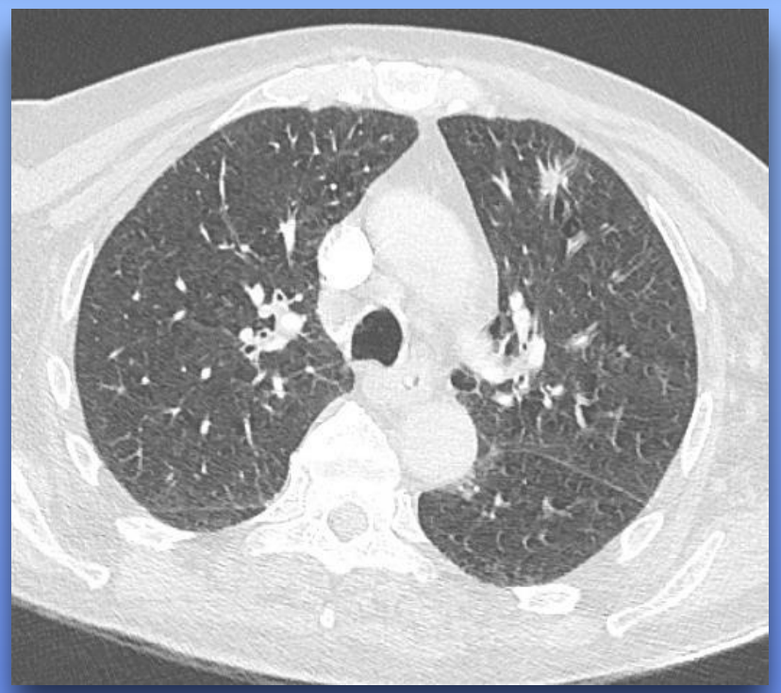
Indication switch

- Mr H… 67 y
- Comorbidities
- Nodule left S^3, 14 mm
- TEP + (SUVm: 3.5)
- CT guided biopsy: SCC
- FEV-1: 1.72 (58%Th)
- DLCO: 35%Th



Planned procedure: Left S^3

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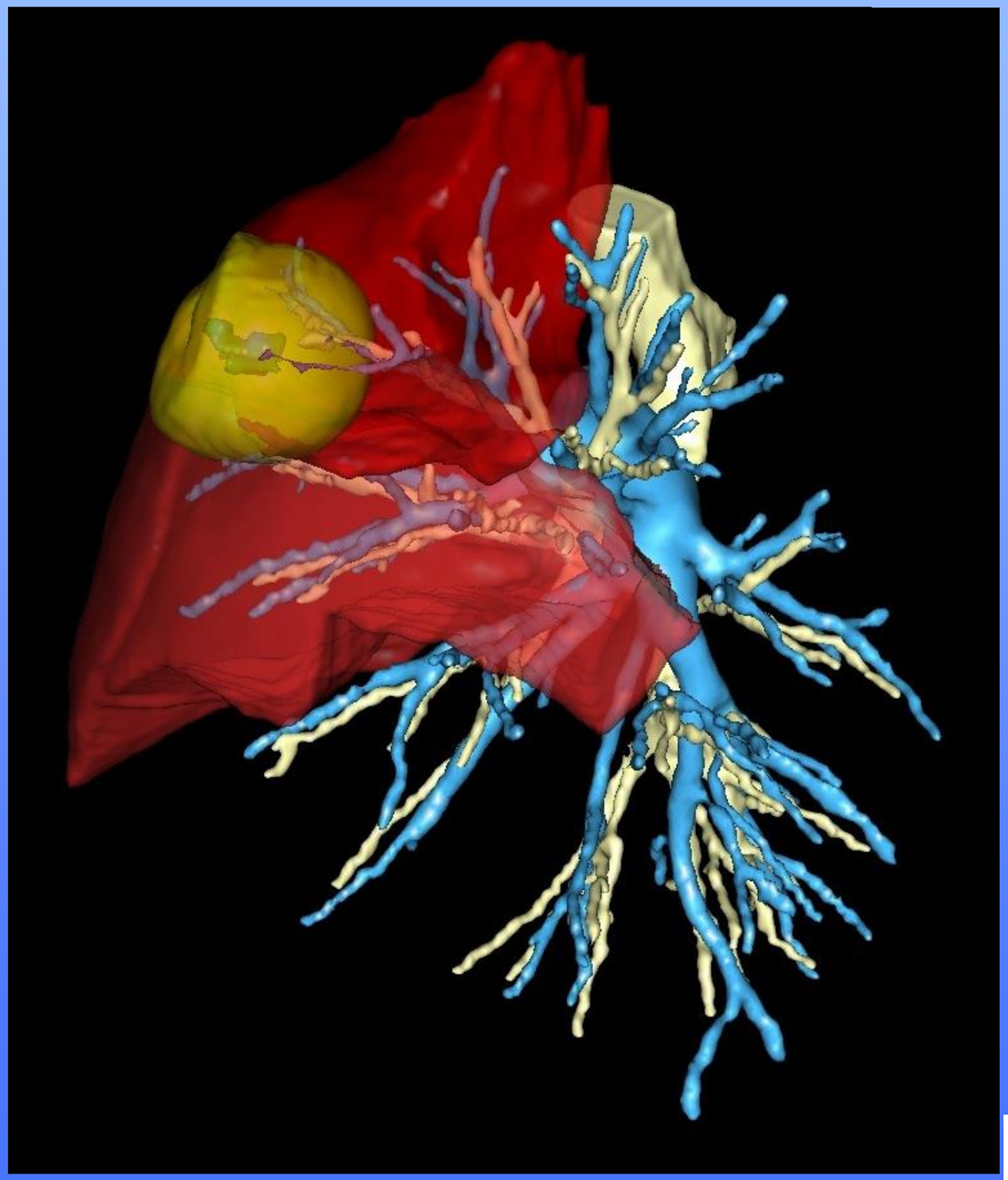

planned procedure: left S^3

SBRT

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Conclusion (1)

- From minimally invasive surgery
- to ultra-minimally invasive surgery
  - Patients selection
  - Precise technique
  - Preoperative planning
    - 3D reconstructions
    - Navigation

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Conclusion (1)

Treatment of stage I lung cancer in high-risk and inoperable patients: SBRT *vs*. RFA *vs*. sublobar resection

Matthew J. Bott, Traves Crabtree

Division of Thoracic Surgery, Washington University School of Medicine, St. Louis, Missouri, USA

	SBRT RTOG0236	SLR ACOSOG Z4032	RFA ACOSOG Z4033
Mortality at D90	0 %	2.4%	2.0%
Complications at D30	-	28 %	2.0%

Ann Cardiothorac Surg 2014;3:167-9

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