

# Intentional Segmentectomies for Stage I Lung Cancer: An Up-to-Date Systematic Review

Benedetta Bedetti<sup>1</sup> · Luca Bertolaccini<sup>2</sup> · Piergiorgio Solli<sup>2</sup> · Joachim Schmidt<sup>1</sup> · Raffaele Rocco<sup>3</sup> · Marco Scarci<sup>4</sup>

Published online: 12 June 2017  
© Springer Science + Business Media New York 2017

## Abstract

**Purpose of Review** The role of this systematic review is to analyse and compare with a meta-analytic approach the outcomes of lobectomy versus intentional segmentectomy in the surgical treatment of stage I non-small cell lung cancer (NSCLC) as reported in the largest studies on the subject published to date.

**Recent Findings** Regarding the results, most of these studies were based on the retrospective data. The size of the cohorts varied from 17 to 11,520 with a total number of 31,684 patients. The pooled hazard ratio was 1.08 (95% CI = 0.97–1.21;  $p = 0.16$ ).

**Summary** The survival in the lobectomy group was not superior to patients treated with intentional segmentectomy in stage I NSCLC. A large numbered, prospective, randomised trials are needed to assess the feasibility of intentional segmentectomy and its oncologic value in this

group of patients, in order to dissolve the questions raised by retrospective data.

**Keywords** Segmentectomy · Lobectomy · Review · Meta-analysis · Early-stage lung cancer · Lung cancer

## Introduction

Until recently, segmentectomies were considered to treat patients with stage I non-small cell lung carcinoma (NSCLC) only in case of poor pulmonary reserve or cardiopulmonary limitations because of their parenchyma sparing-effect. Otherwise, lobectomy with mediastinal lymph node dissection was the standard treatment of choice, open or thoracoscopically, depending on the indication [1, 2].

Recently, the interest of the surgical community has focused on segmentectomies and their application as preferred treatment procedures for early-stage lung cancers. In fact, thoracic surgeons are experiencing an increased number of patients with small pulmonary lesions, due to the technical progress of the thoracic imaging and the use of low-dose computed tomography in screening programmes.

However, whether the outcome of intentional segmentectomies is comparable with lobectomies in patients with early-stage NSCLC is still debated in the scientific community. The role of this systematic review and meta-analysis is to analyse and compare the overall survival (OS) and outcomes of lobectomy versus intentional segmentectomy in the surgical treatment of stage I NSCLC as reported in the largest studies on the subject published to date.

---

This article is part of the Topical collection on *Thoracic Surgery*.

---

Benedetta Bedetti and Luca Bertolaccini contributed equally to the preparation of this article.

---

✉ Benedetta Bedetti  
benedetta.bedetti@gmail.com

<sup>1</sup> Department of Thoracic Surgery, Malteser Hospital, Von-Hompesch-Str. 1, 53123 Bonn, Germany

<sup>2</sup> Department of Thoracic Surgery, AUSL Romagna, Forlì, Italy

<sup>3</sup> Section of Thoracic Surgery, Department of Vascular Surgery, Campus Bio-Medico University of Rome, Rome, Italy

<sup>4</sup> Department of Thoracic Surgery, University College of London Hospitals, London, UK

## Materials and Methods

### Search Strategy and Selection Criteria

Systematic computerised searches in the PubMed, Embase, Cochrane Library databases, and Google Scholar for studies dated up to 30 April 2017 were performed. The eligibility criteria were as follows: stage I NSCLC patients; segmentectomy without wedge resection; comparison of recurrence free survival, OS between lobectomy and segmentectomy. All reference lists from the studies selected by electronic searching were scanned to further identify relevant studies. Meanwhile, the exclusion criteria were patients in case and control groups treated with different surgical procedures; papers not published in English; case reports, abstracts, conference reports or experiments; and papers without any relevant data that could be extracted for analysis. The Cochrane's Collaboration Tool was used to assess the risk of bias for the primary outcome for included studies [3]. The risk of bias due to incomplete outcome data was evaluated at an outcome level, while the risk of bias due to sequence generation, allocation concealment, blinding, selective reporting, or funding was assessed at study level. The risk of bias was assessed by two independent reviewers and disagreements were settled by discussion and consensus.

### Data Analysis

Studies were grouped based on study design (randomised controlled studies and observational studies). A meta-analysis of overall results was conducted. All analyses were performed by using the Review Manager 5.3 (Nordic Cochrane Centre, Copenhagen, Denmark) according to the recommendation of the Cochrane Collaboration. Heterogeneity was measured using  $\chi^2$  test and  $I^2$ . Values of  $p < 0.10$  or  $I^2 > 50\%$  represented substantial heterogeneity.

## Results

Twenty-nine studies were included in our systematic review and meta-analysis [4•, 5•, 6•, 7•, 8•, 9•, 10•, 11•, 12•, 13•, 14•, 15•, 16•, 17•, 18•, 19•, 20•, 21•, 22•, 23•, 24•, 25•, 26•, 27•, 28•, 29•, 30•, 31•, 32•]. Study characteristics are listed in Table 1. Most of the studies were based on retrospective data. The size of the cohorts varied from 17 to 11,520 with a total number of 31,684 patients. In all HR calculations, the lobectomy was chosen as the reference. The pooled HR was 1.08 (95% CI = 0.97–1.21;  $p = 0.16$ ). The lobectomy group was not superior to patients treated with intentional

segmentectomy. The Cochrane tests for heterogeneity showed that  $\chi^2 = 30.70$  degree of freedom = 29 ( $p = 0.38$ );  $I^2 = 6\%$ , which did not suggest a significant inconsistency and heterogeneity between the selected studies. The combined HR displayed in this figure suggested there was no statistical significance between segmentectomy and lobectomy on OS (Fig. 1).

## Discussion

The role of segmentectomy as intentional resection in the surgical treatment of patients with stage I lung cancer is still very debated, principally due to the technical advances of the thoracic imaging and of the minimally invasive techniques. In order to understand what is stated in the literature until today, we collected the data from 29 carefully selected studies published in PubMed from 1990 to 2017 and performed a meta-analysis by combining the OS in segmentectomy and lobectomy groups for patients with early-stage NSCLC.

Overall, the patients who underwent intentional segmentectomies did not have a worse survival than the patients in the lobectomy group. In particular, a relevant advantage of lobectomy over segmentectomy on OS in patients with stage IA lung cancer could not be demonstrated. Our findings are supported from other studies. Cao et al. reported the patients with stage I disease treated with intentional segmentectomies had disease-free survival outcomes that were not significantly different to those undergoing lobectomies. On the contrary, patients with compromised segmentectomies due to reduced cardiopulmonary reserves had a significantly worse OS than lobectomies [33].

Other published data suggested that segmentectomy may have better outcomes only for the subgroups of patients with tumours smaller than 2 cm [34] or in stage IA [35].

This study presents some limitations as, ideally, individual patients data should be used to perform a meta-analysis, but they are rarely available in these settings. Hence, a large number of meta-analyses are performed using data extracted from the literature, which is a well-accepted form of analysis.

This study does not mention any data about additional chemotherapy or radiotherapy, which might have influenced the survival of some patients, as these data were not reported in the analysed papers. It is also reasonable to affirm, that the authors of the papers subjected to the meta-analysis have probably selected the surgical strategy principally based on the clinical stage, as most of the studies did not report whether the stage I was clinical or pathological. Similarly, the comparison between procedures

**Table 1** General characteristics of the enrolled studies

Authors	Years	Sample size	Segmentectomy	Lobectomy	Study design
(1) Read	1990	244	107	131	Retrospective
(2) Warren	1994	173	68	105	Retrospective
(3) Ginsberg	1995	247	122	125	Prospective randomized
(4) Kodama	1997	123	46	77	Retrospective
(5) Bando	2000	213	74	132	Retrospective
(6) Okada	2005	1272	919	258	Retrospective
(7) Koike	2003	223	74	159	Prospective randomized
(8) Keenan	2004	201	54	147	Retrospective
(9) Watanabe	2005	77	20	57	Retrospective
(10) Martin-Ucar	2005	34	17	17	Retrospective
(11) Iwasaki	2007	86	31	55	Retrospective
(12) Okumura	2007	1385	144	1241	Retrospective
(13) Sieneel	2007	199	49	150	Retrospective
(14) Yamato	2008	523	153	277	Retrospective
(15) Kilic	2009	184	78	106	Retrospective
(16) Sugi	2010	144	33	111	Intervention study
(17) Nakamura	2011	411	38	289	Retrospective
(18) Yendamuri	2011	3478	797	2681	Retrospective
(19) Hamatake	2012	143	32	67	Retrospective
(20) Cheng	2012	164	64	120	Retrospective
(21) Soukiasian	2012	251	73	178	Retrospective
(22) Yamashita	2011	214	90	124	Retrospective
(23) Zhong	2012	120	39	81	Retrospective
(24) Tsutani	2013	481	98	383	Retrospective
(25) Landreneau	2014	624	312	312	Retrospective (propensity matched)
(26) Dai	2016	15,760	4240	11,520	Retrospective
(27) Razi	2016	1170	119	1051	Retrospective
(28) Nishio	2016	6905	231	231	Retrospective (propensity matched)
(29) Dziedzic	2017	237	164	73	Retrospective

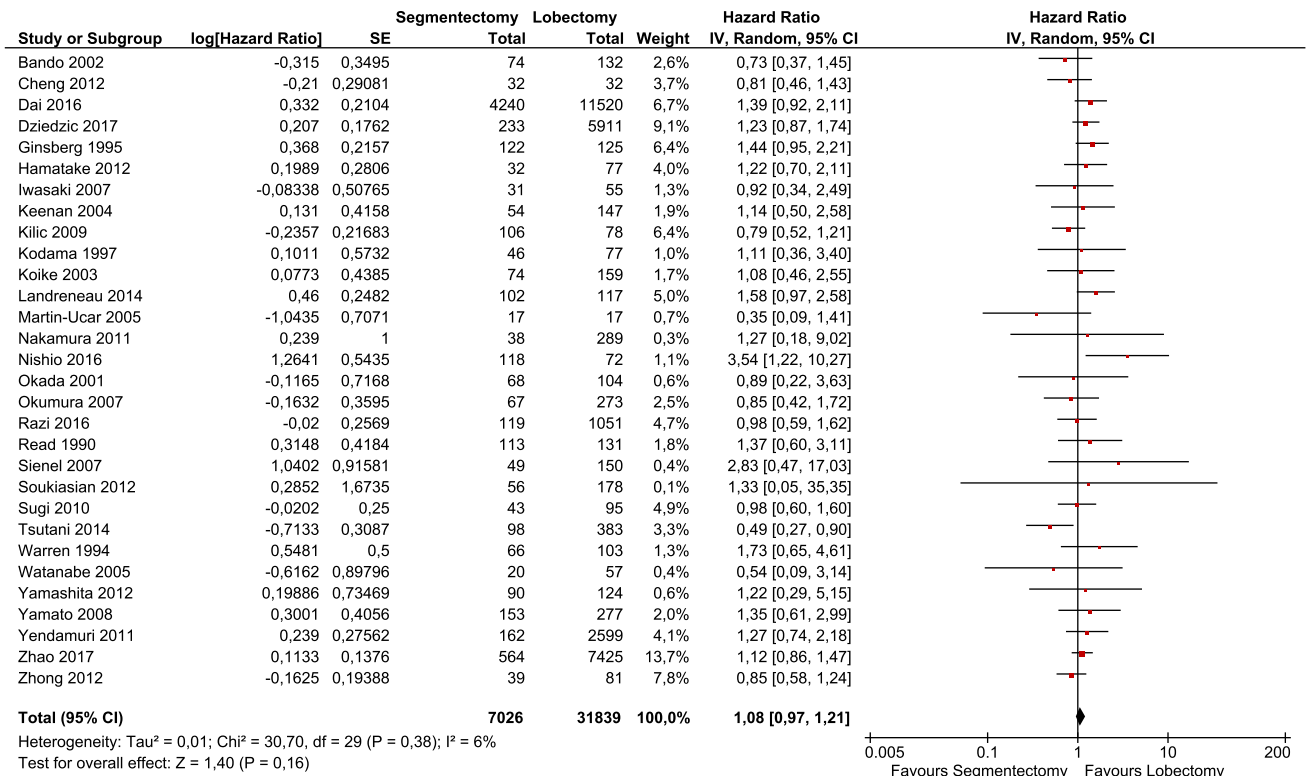
should be more accurate. In fact, the majority of these studies did not differentiate between systematic, or sampling lymphadenectomy, even if there are differences in lymph node management and anatomical approach between the different research groups.

## Conclusion

Our meta-analysis showed that patients who underwent segmentectomies for stage I lung cancer had a similar survival compared to those who underwent lobectomy. Considering the most of the data come from heterogeneous, retrospective studies, the results of this meta-analysis should be interpreted with prudence.

More evidence is needed to determine the role of segmentectomy in early-stage disease. Particularly, a large numbered, prospective, randomised trial is needed, which should answer the questions raised by retrospective data. Currently, two prospective, randomised, multi-institutional phase III trials are being carried out by the Japan Clinical Oncology Group (JCOG 0802) and the Cancer and Leukemia Group B (CALGB 140503) to determine the efficacy of intentional segmentectomies for 2-cm peripheral tumours [36, 37]. The results will probably establish the role of intentional resection for peripheral early-stage tumours.

In conclusion, our analysis shows that carefully selected patients with stage I NSCLC may undergo lung-sparing segmentectomies rather than lobectomies with similar survival outcomes.



**Fig. 1** Forest plot of hazard ratio for overall survival impact of operative approach (segmentectomy vs. lobectomy) of stage I NSCLC patients. The pooled HR displayed in this figure when compared with segmentectomy suggested that there was not a significant benefit of lobectomy on HR of stage I patients (HR = 1.08 [95%

CI = 0.97–1.21; *p* = 0.16]) [7<sup>••</sup>, 8<sup>••</sup>, 9<sup>••</sup>, 10<sup>••</sup>, 11<sup>••</sup>, 12<sup>••</sup>, 13<sup>••</sup>, 14<sup>••</sup>, 15<sup>••</sup>, 16<sup>••</sup>, 17<sup>••</sup>, 18<sup>••</sup>, 19<sup>••</sup>, 20<sup>••</sup>, 21<sup>••</sup>, 22<sup>••</sup>, 23<sup>••</sup>, 24<sup>••</sup>, 25<sup>••</sup>, 26<sup>••</sup>, 27<sup>••</sup>, 28<sup>••</sup>, 29<sup>••</sup>, 30<sup>••</sup>, 31<sup>••</sup>, 32<sup>••</sup>, 33]. *CI* confidence interval, *df* degree of freedom, *HR* hazard ratio, *NSCLC* non-small cell lung cancer, *SE* standard error

**Compliance with Ethics Guidelines**

**Conflict of interest** The authors declare no conflicts of interest relevant to this manuscript.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

**References**

Papers of particular interest, published recently, have been highlighted as:

•• Of major importance

1. Kobayashi N, Kobayashi K, Kikuchi S, Goto Y, Ichimura H, Endo K, Sato Y. Long-term pulmonary function after surgery for lung cancer. *Interact Cardiovasc Thorac Surg.* 2017;24(5):727–32.
2. McMurry TL, Shah PM, Samson P, Robinson CG, Kozower BD. Treatment of stage I non-small cell lung cancer: What’s trending? *J Thorac Cardiovasc Surg.* 2017. doi:10.1016/j.jtcvs.2017.03.122 (Epub ahead of print).
3. Higgins JPT, Green S, editors. *Cochrane handbook for systematic reviews of interventions version 5.1.0.* The Cochrane

Collaboration. 2011. <http://www.cochrane-handbook.org> (updated March 2011).

4. •• Read RC, Yoder G, Schaeffer RC. Survival after conservative resection for T1 N0 M0 non-small cell lung cancer. *Ann Thorac Surg.* 1990;49:391–400. *In this retrospective analysis, the authors describe their experience in the survival and recurrent rate for patients who had lobectomies or segmentectomies for stage I lung cancer.*
5. •• Warren WH, Faber LP. Segmentectomy versus lobectomy in patients with stage I pulmonary carcinoma. Five-year survival and patterns of intrathoracic recurrence. *J Thorac Cardiovasc Surg.* 1994;107:1087–93; discussion 93–4. *In this retrospective analysis, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
6. •• Ginsberg RJ, Rubinstein LV. Randomized trial of lobectomy versus limited resection for T1 N0 non-small cell lung cancer. Lung Cancer Study Group. *Ann Thorac Surg.* 1995;60(3):615–22; discussion 622–3. *In this prospective randomized analysis, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
7. •• Kodama K, Doi O, Higashiyama M, Yokouchi H. Intentional limited resection for selected patients with T1 N0 M0 non-small-cell lung cancer: a single-institution study. *J Thorac Cardiovasc Surg.* 1997;114(3):347–53. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*

8. •• Bando T, Yamagihara K, Ohtake Y, Miyahara R, Tanaka F, Hasegawa S, et al. A new method of segmental resection for primary lung cancer: intermediate results. *Eur J Cardiothorac Surg.* 2002;21(5):894–9; discussion 900. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
9. •• Okada M, Yoshikawa K, Hatta T, Tsubota N. Is segmentectomy with lymph node assessment an alternative to lobectomy for non-small cell lung cancer of 2 cm or smaller? *Ann Thorac Surg.* 2001;71:956–60; discussion 61. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
10. •• Koike T, Yamato Y, Yoshiya K, Kina S, Shimoyama T, Suzuki R. Intentional limited pulmonary resection for peripheral T1 N0 M0 small-sized lung cancer. *J Thorac Cardiovasc Surg.* 2003;125(4):924–8. *In this prospective randomized analysis, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
11. •• Keenan RJ, Landreneau RJ, Maley RH Jr, Singh D, Macherey R, Bartley S, et al. Segmental resection spares pulmonary function in patients with stage I lung cancer. *Ann Thorac Surg.* 2004;78:228–33; discussion 28–33. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
12. •• Watanabe T, Okada A, Imakiire T, Koike T, Hirono T. Intentional limited resection for small peripheral lung cancer based on intraoperative pathologic exploration. *Jpn J Thorac Cardiovasc Surg.* 2005;53:29–35. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
13. •• Martin-Ucar AE, Nakas A, Pilling JE, West KJ, Waller DA. A case-matched study of anatomical segmentectomy versus lobectomy for stage I lung cancer in high-risk patients. *Eur J Cardiothorac Surg.* 2005;27(4):675–9. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
14. •• Iwasaki A, Hamanaka W, Hamada T, Hiratsuka M, Yamamoto S, Shiraishi T, et al. Comparison between a case-matched analysis of left upper lobe trisegmentectomy and left upper lobectomy for small size lung cancer located in the upper division. *Thorac Cardiovasc Surg.* 2007; 55:454–7. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
15. •• Okumura M, Goto M, Ideguchi K, Tamura M, Sasaki H, Tanaka H, et al. Factors associated with outcome of segmentectomy for non-small cell lung cancer: long-term follow-up study at a single institution in Japan. *Lung cancer* 2007;58(2):231–7. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
16. •• Siemel W, Stremmel C, Kirschbaum A, Hinterberger L, Stoelben E, Hasse J, et al. Frequency of local recurrence following segmentectomy of stage IA nonsmall cell lung cancer is influenced by segment localisation and width of resection margins—implications for patient selection for segmentectomy. *Eur J Cardiothorac Surg.* 2007;31:522–8. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
17. •• Yamato Y, Koike T, Yoshiya K, Shinohara H, Toyabe S. Results of surgical treatment for small (2 cm or under) adenocarcinomas of the lung. *Surg Today* 2008;38:109–14. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
18. •• Kilic A, Schuchert MJ, Pettiford BL, Pennathur A, Landreneau JR, Landreneau JP, et al. Anatomic segmentectomy for stage I non-small cell lung cancer in the elderly. *Ann Thorac Surg.* 2009;87:1662–6; discussion 67–8. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
19. •• Sugi K, Kobayashi S, Sudou M, Sakano H, Matsuda E, Okabe K. Long-term prognosis of video-assisted limited surgery for early lung cancer. *Eur J Cardiothorac Surg.* 2010;37:456–60. *In this intervention study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
20. •• Nakamura H, Taniguchi Y, Miwa K, Adachi Y, Fujioka S, Haruki T et al. Comparison of the surgical outcomes of thoracoscopic lobectomy, segmentectomy, and wedge resection for clinical stage I non-small cell lung cancer. *Thorac Cardiovasc Surg.* 2011;59:137–41. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
21. •• Yendamuri S, Gold D, Jayaprakash V, Dexter E, Nwogu C, Demmy T. Is sublobar resection sufficient for carcinoid tumors? *Ann Thorac Surg.* 2011;92(5):1774–8; discussion 1778–9. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
22. •• Hamatake D, Yoshida Y, Miyahara S, Yamashita S, Shiraishi T, Iwasaki A. Surgical outcomes of lung cancer measuring less than 1 cm in diameter. *Interact Cardiovasc Thorac Surg.* 2012;15:854–8. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
23. •• Cheng YD, Duan CJ, Dong S, Zhang SK, Wang SQ, Zhang CF. Clinical controlled comparison between lobectomy and segmental resection for patients over 70 years of age with clinical stage I non-small cell lung cancer. *Eur J Surg Oncol.* 2012;38:1149–55. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
24. •• Soukiasian HJ, Hong E, McKenna RJ Jr. Video-assisted thoracoscopic trisegmentectomy and left upper lobectomy provide equivalent survivals for stage IA and IB lung cancer. *J Thorac Cardiovasc Surg.* 2012;144:S23–6. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
25. •• Yamashita S, Tokuisi K, Anami K, Moroga T, Miyawaki M, Chujo M, et al. Thoracoscopic segmentectomy for T1 classification of non-small cell lung cancer: a single center experience. *Eur J Cardiothorac Surg.* 2012;42:83–8. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
26. •• Zhong C, Fang W, Mao T, Yao F, Chen W, Hu D. Comparison of thoracoscopic segmentectomy and thoracoscopic lobectomy for small-sized stage IA lung cancer. *Ann Thorac Surg.* 2012;94:362–7. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
27. •• Tsutani Y, Miyata Y, Nakayama H, Okumura S, Adachi S, Yoshimura M, et al. Sublobar resection for lung adenocarcinoma meeting node-negative criteria on preoperative imaging. *Ann Thorac Surg.* 2014;97(5):1701–7. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
28. •• Landreneau RJ, Normolle DP, Christie NA, Awais O, Wizorek JJ, Abbas G, et al. Recurrence and survival outcomes after anatomic segmentectomy versus lobectomy for clinical stage I non-

- small-cell lung cancer: a propensity-matched analysis. *J Clin Oncol.* 2014;32(23):2449–55. *In this retrospective propensity matched analysis, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
29. •• Dai CY, Shen J, Ren Y, Zhong S, Zheng H, He J, et al. Choice of surgical procedure for patients with non small-cell lung cancer  $\leq 1$  cm or  $>1$  to 2 cm among lobectomy, segmentectomy, and wedge resection: a population-based study. *J Clin Oncol.* 2016;34:3175–82. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
  30. •• Razi SS, John MM, Sainathan S, Stavropoulos C. Sublobar resection is equivalent to lobectomy for T1a non-small cell lung cancer in the elderly: a Surveillance, Epidemiology, and End Results database analysis. *J Surg Res.* 2016;200(2):683–9. *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
  31. •• Nishio W, Yoshimura M, Maniwa Y, Kitamura Y, Tane K, Takenaka D, et al. Re-assessment of intentional extended segmentectomy for clinical T1aN0 non-small cell lung cancer. *Ann Thorac Surg.* 2016;102(5):1702–10. *In this retrospective propensity matched analysis, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
  32. •• Dziejdz R, Zurek W, Marjanski T, Rudzinski P, Orłowski TM, Sawicka W, et al. Stage I non-small-cell lung cancer: long-term results of lobectomy versus sublobar resection from the Polish National Lung Cancer Registry. *Eur J Cardiothorac Surg.* 2017. doi:10.1093/ejcts/ezx092 (Epub ahead of print). *In this retrospective study, the authors describe their experience in the survival of patients who had lobectomies or segmentectomies for stage I lung cancer.*
  33. Cao C, Chandrakumar D, Gupta S, Yan TD, Tian DH. Could less be more? A systematic review and meta-analysis of sublobar resections versus lobectomy for non-small cell lung cancer according to patient selection. *Lung Cancer.* 2015;89(2):121–32.
  34. Bao F, Ye P, Yang Y, Wang L, Zhang C, Lv X, et al. Segmentectomy or lobectomy for early stage lung cancer: a meta-analysis. *Eur J Cardiothorac Surg.* 2014;46(1):1–7.
  35. Zhang L, Li M, Yin R, Zhang Q, Xu L. Comparison of the oncologic outcomes of anatomic segmentectomy and lobectomy for early-stage non-small cell lung cancer. *Ann Thorac Surg.* 2015;99:728–37.
  36. Blasberg JD, Pass HI, Donington JS. Sublobar resection: a movement from the Lung Cancer Study Group. *J Thorac Oncol.* 2010;5(10):1583–93.
  37. Nakamura K, Saji H, Nakajima R, Okada M, Asamura H, Shibata T, et al. A phase III randomized trial of lobectomy versus limited resection for small-sized peripheral non-small cell lung cancer (JCOG0802/WJOG4607L). *Jpn J Clin Oncol.* 2010;40:271–4.