

Table S1 Studies comparing QOL following lung cancer resection by thoracoscopic or open surgical approach

Authors, year, location	Study design, DBS	Study period	QOL assessment instrument	Time of assessment	Number of patients	Extent of resection [number]	Major findings
Observational studies							
Li <i>et al.</i> , 2002, China	Observational (cross-sectional), 15	1994–2000	EORTC QLQ-C30 + LC-13 (Chinese); 9 self-developed questions	At least 6 months postop (THOR mean 39.4 months postop, VATS mean 33.5 months postop)	N=51; THOR: 24; VATS: 27	Lobectomy	Trend for VATS patients to score higher on QOL and functioning scales and to report fewer symptoms, but no statistically significant difference other than constipation scale which favored patients undergoing VATS No significant difference between VATS and open groups on intermediate and long-term follow-up for QOL and functional status in NSCLC patients with resectable disease without recurrence
Balduyck <i>et al.</i> , 2007, Belgium	Observational (prospective), 15	2002–2004	EORTC QLQ-C30 + LC-13 (Dutch version)	Preoperatively, 1, 3, 6, 12 months postop	N=100; THOR: 92; VATS: 8	Lobectomy [61]; pneumonectomy [17]; wedge [22]	VATS group compared with thoracotomy had significantly more thoracic pain and shoulder dysfunction preoperatively. VATS group had more favorable evolution in physical function, pain in general, and thoracic pain when compared to thoracotomy Lung cancer surgery is well-tolerated in the majority of patients. Postoperative physical functioning, pain, and QOL are in favor of VATS
Aoki <i>et al.</i> , 2007, Japan	Observational (postoperative questionnaire), 15	2001–2002	SF-36	3, 12, 36 months postop	N=33; THOR: 16; VATS: 17	Lobectomy	No statistically significant difference in QOL between VATS and thoracotomy group at 3 and 6 months. Statistically significant difference in QOL scores at 36 months for role-physical and role-emotional with higher scores in the VATS group Bodily pain significantly improved at 36 months in comparison to 3 months for VATS and thoracotomy patients. Thoracotomy patients also had significantly improved scores for mental health at 36 months compared to at 3 months. In thoracotomy patients, role-physical, general health, and physical function scores were significantly lower at 36 months when compared to 3 months, and general health and physical health scores were significantly lower at 36 months compared to 12 months Recovery was quicker in VATS patients compared to thoracotomy
Baysungur <i>et al.</i> , 2011, Turkey	Observational (cross-sectional), 15	2007–2009	SF-36; EORTC QLQ-C30 + LC-13 (Turkish edition)	6 months postop	N=38; THOR: 20; VATS: 18	Lobectomy	Higher SF-36 scores in VATS group at 6 months for physical function and role emotion Higher EORTC QLQ-C30 and LC-13 scores in VATS for functioning scale (cognitive). Better scores in VATS group for lung cancer specific symptoms including coughing, peripheral neuropathy, chest pain, and arm/shoulder pain VATS lobectomy group has better QOL scores than thoracotomy patients at 6 months postoperatively with reduced postoperative pain in the chest and peripheral neuropathy
Handy <i>et al.</i> , 2010, USA	Observational (retrospective), 16	1998–2007	SF-36; QLI	Preoperatively, 6 months postop	N=241; OPEN: 192; VATS: 49	Lobectomy	VATS associated with same or better (pain and general health) QOL categories when preop and 6 months postop scores were compared. Open group had significantly worse physical functioning, role-physical, and social functioning when their preop and 6 months postop scores were compared Change in SF-36 preop and 6 months scores were significantly better outcomes in the VATS group for physical function, role-physical, bodily pain, and general health QLI scores were not different preop and at 6 months postop between the two groups Functional health recovery for VATS appears to be superior to open techniques
Cerfolio <i>et al.</i> , 2018, USA	Observational (retrospective cohort), 12	2010–2011	SF-12; NRS (pain score 0–10)	Preoperatively, 3 weeks, 4 months postop	N=424; THOR: 318; RATS: 106	Lobectomy	Patients undergoing 4-arm robotic lobectomy had reduced morbidity, shorter LOS, and improved mental QOL at 3 weeks compared to propensity-matched patients who underwent rib/nerve-sparing thoracotomy approach
Rizk <i>et al.</i> , 2014, USA	Observational (prospective cohort), 19	2009–2012	BPI (pain); SF-36	BPI: preoperatively, POD 2–4, 4, 8, 12 months postop; SF-36: preoperatively, 1 st postop visit (2 weeks), 4, 8, 12 months postop	N=206; THOR: 74; VATS/RATS: 132	Lobectomy; segmentectomy	PCS and BPI scores were similar between the two groups during the 12 months of follow-up MCS score was worse in the VATS group. QOL score improved throughout the 12 months. Pain scores approached baseline by 4 months
Zhao <i>et al.</i> , 2015, China	Observational (prospective), 16	2010–2012	SF-36	1, 6, 12 months postop	N=217; OPEN: 103; VATS: 114	Lobectomy	VATS significantly better than open in scores for bodily pain, energy, and role physical VATS group tends to score higher on the QOL and functioning scales when compared with open lobectomy for patients with stage II NSCLC
Fagundes <i>et al.</i> , 2015, USA	Observational (prospective), 16	2004–2008	MDASI	Preoperatively, POD3, POD5, weekly from 1 week post discharge to 3 months postop	N=60; THOR: 31; VATS: 29	Unspecified	Most severe postoperative symptoms were pain, fatigue, drowsiness, SOB, disturbed sleep. VATS patients experienced faster resolution of pain
Shi <i>et al.</i> , 2016, USA	Observational (prospective longitudinal), 16	Unspecified	MDASI; SF-12	Preoperatively, POD3, POD7, then weekly until 3 months postop	N=72; THOR: 40; VATS: 32	Unspecified	Interference scores of VATS patients versus thoracotomy returned more quickly to baseline levels for walking, mood, relations with others, and enjoyment of life. No difference for general activity and work
Rauma <i>et al.</i> , 2016, Finland	Observational, 15	2000–2009	15D; EORTC QLQ-C30 + LC13	Sent June 2011 (range: 2–11 years postop, median 4.85 years)	N=230; THOR: 188; VATS: 42	Pneumonectomy [18]; lobectomy [182]; sleeve [13]; sublobar [17]	VATS associated with worse long-term HRQoL (15D) No baseline 15D obtained. VATS patients may have had a poor HRQoL before surgery. Positive correlation between probability of undergoing VATS and comorbidities, which showed a strong negative effect on HRQoL
Khullar <i>et al.</i> , 2017, USA	Observational (prospective cohort), 18	2014–2016	PROMIS	Preoperatively, 1, 6 months postop	N=127; THOR: 24; VATS: 103	Lobectomy [83]; wedge [18]; segmentectomy [14]; pneumonectomy [9]; bilobectomy [3]	Thoracotomy (compared to VATS) associated with significantly worse physical function scores at baseline and initial postoperative assessment Suggested that identified difference in physical function is likely a result of baseline differences between cohorts
Schwartz <i>et al.</i> , 2017, USA	Observational (retrospective), 16	2001–2014	SF-12	Preoperatively, 1-year postop	N=100; THOR: 85; VATS: 15	Wedge [12]; segmentectomy [11]; lobectomy [73]; bilobectomy [4]	No difference of statistical significance in QOL between the two groups from pre- to postop when adjusted for sex, age, smoking, ethnicity, and education. Physical component score and emotional component score significantly worsened in the thoracotomy group from pre- to postop; this was only significant in patients who underwent lobectomy
Hopkins <i>et al.</i> , 2017, USA	Observational (prospective cross sectional), 18	2010–2014	NAS (pain score 0–10); HADS (mood); FACT-L	3–12 months postoperatively	N=97; THOR: 66; VATS: 31	Pneumonectomy/bilobectomy [7]; lobectomy [56]; wedge [15]; segmentectomy [19]	No significant difference between VATS and thoracotomy patients in ratings of chronic pain, mood disorders, and QOL VATS and thoracotomy patients had similar late QOL outcomes
Randomized clinical trial							
Bendixen <i>et al.</i> , 2016, Denmark	Randomized controlled trial, 22	2008–2014	NRS (pain score 0–10); EORTC QLQ-C30; EQ5D	NRS: 6 times per day, POD 1–2, 2, 4, 8, 12, 26, and 52 weeks postop; EORTC C30, EQ5D: Preoperatively, 2, 4, 8, 12, 26, and 52 weeks postop	N=201; THOR: 99; VATS: 102	Lobectomy	QOL (EQ5D) significantly better after VATS during 52 weeks of follow-up. QOL (QLQ-C30) was not significantly different between the groups during the whole study period; however, emotion function was significantly better in the VATS group when evaluated in separate domains VATS is associated with better QOL and less postoperative pain than anterolateral thoracotomy for the first year after surgery

QOL, quality of life; DBS, Downs and Black Quality Score; EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire; LC-13, lung-cancer specific module; THOR, thoracotomy; VATS, video-assisted thoracoscopic surgery; NSCLC, non-small-cell lung cancer; SF-36, short-form health survey (36 questions); QLI, Ferrans and Powers quality of life index; OPEN, open surgical approach; SF-12, short-form health survey (12 questions); NRS, numeric pain assessment scale; RATS, robotic-assisted thoracic surgery; LOS, length of stay; BPI, brief pain index; PCS, physical component survey; MCS, mental component survey; POD, postoperative day; MDASI, MD Anderson symptom inventory; SOB, shortness of breath; HRQoL, health related quality of life; PROMIS, patient-reported outcomes measurement information system; HADS, hospital anxiety and depression scale; FACT-L, functional assessment of cancer therapy-lung; EQ5D, European quality of life 5 dimensions.

Table S2 QOL assessment instruments in studies comparing minimally-invasive and open approach

Assessment instrument	Number of questions	Scoring	Symptoms	General health perception	Physical functioning	Social functioning	Cognitive functioning	Emotional functioning	Role functioning	Other domains	Cancer-specific	Population
PROMIS	1,894 questions, 97 adult domains	Each question scored in range 1–5; total raw score is sum of values of response to each question	Dyspnea, pain, itching, diarrhea, constipation, gas/bloating, reflux, nausea, vomiting, abdominal pain	“Global health”	“Physical health”	“Social health”	“Mental health”	Alcohol use, cognitive function abilities, psychosocial illness impact, smoking, negative health expectancies	Dyspnea, functional limitations, task avoidance, time extension	Multiple	General cancer question bank for anxiety, depression, fatigue, pain interference, physical functioning	Adults and children with chronic conditions
SF	8, 12, or 36 questions; 8 total domains	Each question scored 0–100 (100 represents highest level of functioning). Aggregate scores compiled as % of total points possible using RAND scoring table	Pain	“General health and vitality”	Yes	Yes	“Mental health”	“Role emotional”	“Role physical”	Reported health transition	No	Unclear
MDASI	19 total questions, (core + disease-specific modules, 13 symptoms; 6 domains/symptom interference)	Scored on scale of 0–10, (10 most severe)	Pain, fatigue, nausea, disturbed sleep, distress, SOB, impaired memory, anorexia, drowsiness, dry mouth, sadness, vomiting, numbness/tingling	No	Walking	“Relations with others”	“Mood”	“Enjoyment of life”	“Working and general activity”	None	Lung-cancer specific module	English, Dutch, Serbian languages
FACT-L	27 total questions, 5 domains	Each question scored on scale 0–4; total score range 0–136 (higher score means higher QOL)	Weight loss, SOB, chest tightness, cough	No	“Physical well-being”	“Social/family well-being”	“My thinking is clear”	“Emotional well-being”	“Functional well-being”	“Additional concerns”, tobacco use, hair loss, breathing, thinking clearly, appetite	Lung-cancer specific	Lung cancer patients
HADS	14 items (7 anxiety, 7 depression)	Total scored on scale 0–21 either anxiety or depression	No	No	No	No	No	“Anxiety and depression”	No	No	No	Unclear
15D	15 questions	Each question scored 1–5 (5 is worse QOL)	Discomfort and impaired vision, hearing, breathing, eating, speech, excretion	“Vitality”	“Mobility”	No	“Mental function”	“Distress” and “Depression”	“Usual activities”	“Sexual activity”	No	Adults 16+
Ferrans and Powers QLI-cancer version	66 questions, 4 domains	Each question scored on scale 1–6 (6 is very satisfied)	No	“Health and functioning”	No	“Social and economic”	No	“Psychological/spiritual”	“Health and functioning”	“Family”	Yes	Cancer patients
EQ5D	5 questions (“dimensions”)	Each dimension has 5 levels: (1 is no problems to 5 extreme problems). Number assigned to each level and 5-digit number generated to describe health state	Pain, discomfort	No	“Mobility”	No	No	“Anxiety/depression”	“Usual activities”	“Self-care”	No	Adults

QOL, quality of life; PROMIS, patient-reported outcomes measurement information system; MDASI, MD Anderson symptom inventory; SOB, shortness of breath; HADS, hospital anxiety and depression scale; FACT-L, functional assessment of cancer therapy-lung; HADS, hospital anxiety and depression scale; QLI, Ferrans and Powers quality of life index; EQ5D, European quality of life 5 dimensions.