Prostatectomy

Study	Cohort	Positive Surgical Margins	Potency	Continence	Other
Tewari et al (2012)	n=286,876 systematic review	4.2% less vs lap 8% less vs open			
Robertson et al (2013)	n=19,064	6% less vs lap			
Evans et al (2012)	n= 2,385	Less likely to have PSM p=0.002			
Webb et al (2011)	n=400	8.5% less vs open			
Ficarra et al (2012)	Systematic review of 44 studies Only included studies with n>100		More likely to be potent at 12months p= 0.002		
Ficarra et al (2012)	Systematic review of 51 studies			More likely to be continent at 12 months (p=0.03 vs open, p=0.006 vs lap)	
Porpiglia et al (2012)	n=120, randomised controlled trial		25.8% more likely to be potent at 12 months vs lap	Improved continence vs lap at all time points up to 12 months	
Ficarra et al (2009)		0.5% less likely to have positive surgical margin vs open	32% more likely to be potent at 12 months vs open	50 days earlier return to continence	
Rocco et al (2009)		2% less likely to have a positive surgical margin	20% more likely to be potent at 12 months	10% more likely to be continent at 6 months	
Carlsson et al (2010)					Reduced major complication rates p<0.001
Trinh et al (2012)					Reduced overall complication rates p<0.001
Park et al (2012)			Improved potency vs lap at all time points up to 12 months	Improved continence vs lap at all time points up to 12 months	Significantly reduced post op pain and OR time
Hohwü et al 2009	n=274				38 less paid sick days vs open
Basto et al (2015)					2.2 days reduced LOS vs lap 3.4 days reduced LOS vs open 6% less blood transfusions vs lap 15% less blood transfusions vs open

Key Themes:

da Vinci Prostatectomy is associated with reduced positive surgical margins, reduced length of stay, reduced surgical complications and faster return to potency and continence.

References:

Tewari et al (2012). Positive surgical margin and perioperative complication rates of primary surgical treatments for prostate cancer: a systematic review and meta-analysis comparing retropubic, laparoscopic, and robotic prostatectomy. European Urology, 62, 1-15.

Robertson et al (2013). Relative effectiveness of robot-assisted and standard laparoscopic prostatectomy as alternatives to open radical prostatectomy for treatment of localised prostate cancer: a systematic review and mixed treatment comparison meta-analysis. BJU International, 112, 798-812.

Carlsson et al (2010). Surgery-related complications in 1253 robot-assisted and 485 open retropubic radical prostatectomies at the Karolinska University, Hospital Sweden. Urology, 75, 1092-1097.

Trinh et al (2012). Perioperative outcomes of robot-assisted radical prostatectomy compared with open radical prostatectomy: results from the nationwide inpatient sample. European Urology, 61, 679-685.

Ficarra et al (2012). Systematic Review and Meta-analysis of Studies reporting Potency Rates After Robot-assisted Radical Prostatectomy. European Urology, 62, 418-430.

Ficarra et al (2012) Systematic Review and Meta-Analysis of Studies Reporting Urinary Continence Recovery After Robot-assisted Radical Prostatectomy. European Urology, 62, 405-417.

Porpiglia et al (2012). Randomised Controlled Trial Comparing Laparoscopic and Robot-assisted Radical Prostatectomy. European Urology, 63, 606-615.

Basto et al (2015) Patterns-of-care and health economic analysis of robot-assisted radical prostatectomy in the Australian public health system. BJU International, Epub ahead of print, September 9 2015.

Partial Nephrectomy

Study	Cohort	LOS Decrease	Complications	Cancer Control	Operative Time	Other
Benway et at (2009)	n=247	0.3 day vs lap		Equivilant vs lap	Equivilant vs lap	9.9-10.8min decreased warm ischaemic time (maximizing renal preservation)
Ferguson et al (2012)	n=89	1 day vs lap				
Chandra et al (2015)	n=17,039 in the 7 cm cohort (tumor size) n=9,750 in the 4 cm cohort (tumor size)					Adoption of robotic surgery in a hospital referring region (HRR) led to a 52% increase in the rate of partial nephrectomy. 5-year economic valuation: Benefits outweighed cost by a 5:1 ratio (quality-adjusted life-years gained vs. health care and surgical costs of MIS robotic surgery for partial nephrectomy)
Patel et al (2013)	n= 14,260					Data suggests that robotic technology may enable surgeons across practice settings to more

						frequently perform nephron sparing surgery
Khalifeh et al (2012)	n=500		Decreased intraop complications by 3% Decreased postop complications by 7.5%	Decreased positive surgical margins by 2.7%	Decreased by 21.8 vs lap	

Key Themes:

da Vinci surgery enables more nephron sparing renal surgeries for renal cancer. Nephron sparing is critical for renal function preservation. Increasing nephron sparing reduces the burden of chronic renal failure by preserving renal function.

References:

Ferguson et al (2012). Cost Analysis of Robot-Assisted Laparoscopic Versus Hand-Assisted Laparoscopic Partial Nephrectomy. Journal of Endourology, DOI: 10.1089/end.2011.0568

Chandra et al (2015). Robot-assisted surgery for kidney cancer increased access to a procedure that can reduce mortality and renal failure. HEALTH AFFAIRS, 2015;34(2):220-228.

Patel HD, Mullins JK, Pierorazio PM, et al. Trends in renal surgery: robotic technology is associated with increased use of partial nephrectomy. J Urol 2013;189:1229-1235

Khalifeh et al (2012). Comparative Outcomes and Assessment of "Trifecta" in 500 Robotic and Laparoscopic Partial Nephrectomies: A Single Surgeon Experience. The Journal of Urology (2012), doi:10.1016/j.juro.2012.10.021.

Hysterectomy for Cancer

Study	Cohort	LOS decrease	Blood Loss decrease	Operative Time	Complications
Salom et al (2015)	n=175	2 days	350ml vs open	Equivalent	Equivalent
Silasi et al (2013)	n=60	1.5 days	275ml vs open	100min increase	
Yim et al (2014)	n=102	Equivilant	45ml vs lap	Equivalent	Decreased 14.2% vs lap
Lavoue et al (2014)	n=163	3 days	259ml vs open	27min increase	
Lau et al (2012)	n=303	3.3 days	150ml (decrease transfusions by 4.9%)	27min increase	Decrease 29%
Boggess et al (2008)	n=322	0.2 vs lap	71.3ml vs lap	44.7min decrease vs Lap	Decreased 7.8% vs lap
		3.4 vs open	191.5ml vs open	22.2min increase vs open	Decreased 23.9% vs open
Estape et al (2009)	n=63	0.3 days vs lap	79.4ml vs lap	12min increase vs lap	Decreased 4.7% vs lap
		1.4 days vs open	491.4ml vs open	30min increase vs open	Decreased 9.8% vs open
Paley et al (2011)	n=508	3.9 days vs open	150.7ml vs open		Decreased 14.2% vs open
Seamon et al (2009)	n=254	2 days vs open	285ml vs open		Decreased 16% vs open

Key Themes:

da Vinci Hysterectomy for cancer is associated with decreased length of hospital stay, decreased blood loss and decreased complications. It is also associated with an increase in operative times

References:

Robotic Versus Abdominal Hysterectomy for Very Large Uteri
Silasi et al (2013) *Journal of the Society of Laparoendoscopic Surgeons*

Radical abdominal and robotic hysterectomy: Perioperative and oncologic outcome of 175 cases
Salom et al (2015) *Gynecologic Oncology*

Surgical Outcomes of Robotic Radical Hysterectomy Using Three Robotic Arms versus Conventional Multiport Laparoscopy in Patients with Cervical Cancer
Yim et al (2014) *Yonsei Medical Journal*

Impact of robotics on the outcome of elderly patients with endometrial cancer
Lavoue et al (2014) *Gynecologic Oncology*

Outcomes and Cost Comparisons After Introducing a Robotics Program for Endometrial Cancer Surgery
Lau et al (2012) *Obstetrics and Gynecology*

A comparative study of 3 surgical methods for hysterectomy with staging for endometrial cancer: robotic assistance, laparoscopy, laparotomy
Boggess et al (2008) *American Journal of Obstetrics and Gynecology*

A case matched analysis of robotic radical hysterectomy with lymphadenectomy compared with laparoscopy and laparotomy
Estape et al (2009) *Gynecologic Oncology*

Surgical outcomes in gynecologic oncology in the era of robotics: analysis of first 1000cases
Paley et al (2011) *American Journal of Obstetrics and Gynecology*

Seamon LG, Bryant SA, Rheaume PS, Kimball KJ, Huh WK, Fowler JM, Phillips GS, Cohn DE. Comprehensive surgical staging for endometrial cancer in obese patients: comparing robotics and laparotomy. Obstet Gynecol. 2009 Jul;114(1):16-21.

Benign Hysterectomy

Key Themes:

Study	Cohort	LOS (days)	Intra op Complications	Post op Complications
Lim et al (2016)	2,300 da Vinci, 9,745 Open, 8,121 vaginal, 11,952 lap	1.37 da Vinci 3.0 open 1.9 vaginal 1.7 lap	0.7% da Vinci 1.8% open 1.8% vaginal 1.2% lap	6.3% da Vinci 21% open 16.2% vaginal 16.3% lap

da Vinci Surgery can allow more complex hysterectomy procedures to be performed minimally invasively, with lower complications, lower LOS, and complication rates compared with all traditional surgical techniques.

References:

Lim et al (2016). Multicenter analysis comparing robotic, open, laparoscopic, and vaginal hysterectomies performed by high-volume surgeons for benign indications. *International Journal of Gynecology & Obstetrics*

Colorectal Surgery

Colon Surgery	Patient Population	EBL, mL	Conversion Rate, %	Complication Rate, %
Weber (2002)[17]	2	NR	0.0	0.0
Delaney (2003)[18]	5	140	9.6	20.0
D'Annibale (2004)[19]	53	21	9.4	7.5
de Noto (2006)[20]	11	NR	9.1	NR
Rawlings (2007)[21]	30	62	6.7	15.7
Spinoglio (2008)[22]	50	NR	4.0	14.0
de Souza (2010)[23*]	40	50	2.5	20.0
Park (2012)[24]	35	36	0.0	17.1
da Vinci®	**226**	**42**	**5.1%**	**14.3%**
COLOR Trial[25]	534	100	17.0	21.0
COST Trial[26]	435	N/A	21.0	21.0
MRC CLASSIC[15]	185	N/A	25.0	26.0
Laparoscopy	**1154**	**100**	**19.8%**	**21.8%**

Rectal Surgery	Patient Population	Positive CRM, %	Conversion Rate, %	LOS days	Complication Rate, %
Pigazzi (2006)[1]	6	NR	0.0	4.5	1
Hellan (2007)[2]	39	0.0	1.0	4.0	5
Baik (2008)[3]	18	NR	0.0	7.0	4
Patriti (2009)[4]	29	0.0	0.0	11.9	7
Baik (2009)[5]	56	7.1	0.0	5.0	3
Park (2010)[6]	41	1.9	0.0	9.9	12
Pigazzi (2010)[7]	143	0.7	7.0	9.3	59
Bianchi (2010)[8]	25	0.0	0.0	6.5	4
Baek (2010)[9]	64	0.0	6.0	5.0	23
Baek (2011)[10]	41	2.4	3.0	6.5	9
Kwak (2011)[11]	59	1.7	0.0	NR	19
Park (2011)[12]	52	2.4	0.0	10.0	10
Kang (2013)[13]	165	4.2	0.6	10.8	21
D'Annibale (2013)[14]	50	0.0	0.0	8.0	10
da Vinci®	**788**	**2.1%**	**2.1%**	**8.2**	**22%**
MRC Classic[15]	242	16.0	34.0	10.0	32
COLOR II[16]	739	10.0	17.0	8.0	49
Lap	**981**	**11.0%**	**21.0%**	**8.5**	**38%**
MRC Classic[15]	132	14	N/A	13.0	37
COLOR II[16]	364	10	N/A	9.0	37
Open	**496**	**11.0%**	**N/A**	**10.1**	**37%**

Key themes:

da Vinci Colorectal Surgery is associated with decreased length of hospital stay, decreased conversion to open surgery, decreased blood loss and decreased complications.

References:

Pigazzi A, Ellenhorn JD, Ballantyne GH, et al. Robotic-assisted laparoscopic low anterior resection with total mesorectal excision for rectal cancer. Surg Endoc. 2006;20:1521-1525.

Hellan M, Anderson C, Ellenhorn JD, et al. Short-term outcomes after robotic-assisted total mesorectal excision for rectal cancer. Ann Surg Oncol. 2007;14:3168-3173.

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Pigazzi A, Luca F, Patriti A, et al. Multicentric study on robotic tumor specific mesorectal excision for the treatment of rectal cancer. Ann Surg Oncol. 2010;17:1614-1620.

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Trans-Oral Robotic Surgery

Study	Cohort	LOS Decrease	Cancer Control	Adjunct Therapy	Other
Dean et al (2010)	n=36	3.2 days robotic vs open salvage	100% negative surgical margins vs 86% open		0% Gastrostomy tube dependent at 6months vs 43% open 0% tracheotomy tube dependent at 6months vs 7% open
Weinstein et al (2010)	n=31		100% negative margins	22.6% none 38.7% radiation 38.7% chemoradiation	Regional control rate 100% 2 year PEG dependency 0%
White et al (2010)	n=89		89.3% 1 year cancer free survival 86.3% 2 year cancer free survival		0% dependence on gastrostomy tube at 2 years
Chen et al (2014)	n=9,415		10.8% less likely to have positive surgical margins		
Chung et al (2015)	n=2,067	1.5 days robotic vs open partial pharyngectomy			Significantly less likely to have a tracheostomy: 25.9% in mild to moderate cases, 57.8% less likely in major-extreme cases
Hammoudi et al (2014)	n=26	Significantly shorter LOS in TORS group p=0.001			Less tracheotomies with TORS p<0.001

					Shorter duration of NG Tube p=0.01 Significantly cheaper cost of surgery (p<0.001), hospitalisation (p=0.01) and treatment (p=0.03) in TORS group.
Richmon et al (2014)	n=9,601 (116 da Vinci)	1.5 days reduced LOS			$4,285 (mean) reduction in hospital related costs

Key Themes:

Trans-Oral Robotic Surgery is associated with improved cancer outcomes, reduced length of stay and improved long term functional outcomes when compared to non-robotic surgical techniques.

References:

Dean et al (2010). Robotic-Assisted Surgery for Primary or Recurrent Oropharyngeal Carcinoma. Arch Otolaryngol Head Neck Surg, 2010;136(4):380-3.

Weinstein et al (2010). Selective Neck Dissection and Deintensied Postoperative Radiation and Chemotherapy for Oropha-ryngeal Cancer: A Subset Analysis of the University of Pennsylvania Transoral Robotic Surgery Trial. Laryngoscope, 2010;120:1749-55.

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Chung et al (2015). Transoral Robotic Surgery for Oropharangeal and Tongue Cancer in the United States. The Laryngoscope. 00, 1-6.

Hammoudi et al (2014). Transoral robotic surgery versus conventional surgery in the treatment for squamous cell carcinoma of the upper aerodigestive tract. Head and Neck, 1-6.

Richmon et al (2014). The Effect of Transoral Robotic Surgery on Short-Term Outcomes and Cost of Care after Oropharyngeal Cancer Surgery. The Laryngoscope. 124(1), 165-171

Upper GI – Hepatobiliary Surgery

Study	Cohort	LOS Decrease	Cancer Control	Blood Loss	Other
Daouadi et al (2013)	30 robotic distal pancreatectomy vs 94 historic lap distal pancreatectomy	1 day reduced LOS	Improved lymph node yield for both benign and malignant lesions (P < 0.0001)	Reduced risk of excessive blood loss	Less likely to convert to open surgery (P <0 .05)
Cirocchi et al (2013)	13 studies 207 patients	Significantly reduced LOS P < 0.05			
Ho et al (2012)	>200 patients				Robotic liver resection is safe and feasible for experienced surgeons with advanced laparoscopic skills.

Daouadi et al (2013) “Robot-Assisted Minimally Invasive Distal Pancreatectomy Is Superior to the Laparoscopic Technique” Annals of Surgery. 257(1), 128-132

Cirocchi et al (2013). A systematic review on robotic pancreatico-duodenectomy. Surgical Oncology. (22) 238-246

Ho et al (2012). Systematic review of robotic liver resection. Surgical Endoscopy. 27:732–739

Upper GI – Bariatric Surgery

Study	Cohort	LOS Decrease	Complications	Leak Rate	Other
Buchs et al (2014)	n=777	4.2 days decreased LOS (6.2 vs. 10.4 days; p=0.0001)	Less complications (11.6%vs. 16.7 %; p=0.05)	Less gastrointestinal leaks (0.3 vs. 3.6 %; p=0.0009)	Lower conversion to open (0.8 vs. 4.9 %; p=0.0007)
Snyder et al (2013)	356 laparoscopic 249 robotic			No leaks in the robotic series, and six (1.7%) in the standard laparoscopic series (p = 0.04)	
Markar et al (2011)	1686 patients				There was a significantly reduced incidence of anastomotic stricture in the robotic group (POR=0.43; 95% CI=0.19 to 0.98; p=0.04)
Hagen et al (2012)	524 open 323 laparoscopic 143 robotic	1 day shorter LOS vs laparoscopic 2 days shorter LOS vs open		Significantly more anastomotic leaks and strictures occurred after laparoscopic RYGBP (4%, 6.8%) when compared to the open (1.9%, 1.1%) and robotic approaches (0%, 0%).	There were significantly fewer conversions to open surgery during robotic RYGBP (1.4%) when compared to laparoscopy (4.9%)

Buchs et al (2014). “Laparoscopic Versus Robotic Roux-En-Y Gastric Bypass: Lessons and Long-Term Follow-Up Learned From a Large Prospective Monocentric Study.” Obesity Surgery

Snyder et al (2008). “Lowering gastrointestinal leak rates: a comparative analysis of robotic and laparoscopic gastric bypass.” Journal of Robotic Surgery

Markar et al (2011). “Robotic vs. laparoscopic Roux-en-Y gastric bypass in morbidly obese patients: systematic review and pooled analysis.” The International Journal of Medical Robotics and Computer Assisted Surgery. 7: 393–400

Hagen et al (2012). “Reducing Cost of Surgery by Avoiding Complications: the Model of Robotic Roux-en-Y Gastric Bypass.” Obesity Surgery. 22:52–61

Thoracic Surgery

Study	Cohort	LOS Decrease	Complications	Chest Tube Duration	Other
Adams et al (2014)	116 robotic 4,612 VATS 5,913 Open	0.6 days less vs VATS 2.6 days less vs open	Less blood transfusions post op (P = 0.002)	0.5 days less vs VATS 1.6 days less vs open	
Cerfolio et al (2011)		2.0 days less vs open (P = .02)			Reduced morbidity (27%vs 38%; P = 0.05) Improved mental

					quality of life (53 vs 40; P<.001)

Adams et al (2014). “Initial Multicenter Community Robotic Lobectomy Experience: Comparisons to a National Database.” The Annals of Thoracic Surgery, 97(6): 1893–1900

Cerfolio et al (2011). “Initial consecutive experience of completely portal robotic pulmonary resection with 4 arms.” Journal of Thoracic and Cardiovascular Surgery. 142:740-746