
ROBOTIC & COMPUTER ENHANCED SURGERY CENTER | University of North Carolina at Chapel Hill
Robotic Applications in Gynecologic Oncology
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University of North Carolina
at Chapel Hill
USA


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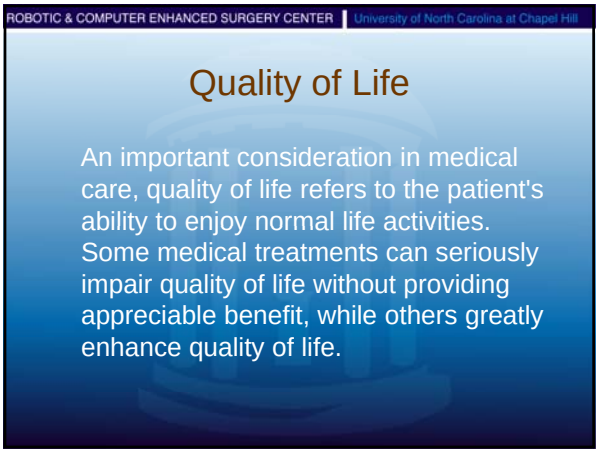
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Quality of Life
An important consideration in medical care, quality of life refers to the patient's ability to enjoy normal life activities. Some medical treatments can seriously impair quality of life without providing appreciable benefit, while others greatly enhance quality of life.

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Surgery is a "Controlled Injury"

- Bleeding
- Infection
- Scarring
- Bowel Dysfunction
- Wound Complications
- Pain

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Cancer Surgery

- Therapeutic
- Diagnostic

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Clinical Applications

- Cardiac Surgery
- Urology
- Thoracic
- General Surgery

- Gynecology
  FDA approved, April 2005

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Objectives

- Explore indications in gynecology oncology
- Develop reproducible techniques
- Teach and demonstrate
- Catalogue outcomes

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Teaching programs

- Video documentation
- Procedure manual
- Webcast
- Case observations
- Training course

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Procedures Performed

- Hysterectomy
  - Simple
  - Radical
- Lymph-node Dissection
  - Pelvic
  - Para-aortic
- Oophorectomy
- Ovarian Cystectomy in Pregnancy
- Vaginectomy
- Uretero-ureterostomy
- Ovarian Remnant
- Post-hyst Staging
- Radical Parametrectomy
- Radical Traechelectomy
- Pelvic Exenteration
- Ileal Conduit

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Clinical Experience To Date

Hysterectomy	340
Radical Cervical	102
Endometrial Cancer Staging	246
Other	79
Total	767

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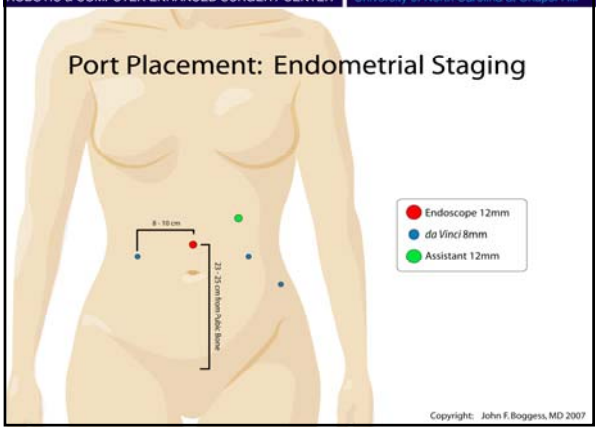
Port Placement: Endometrial Staging



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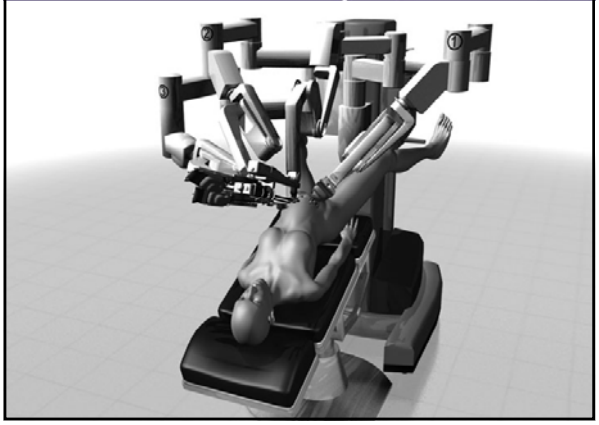

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Pre-operative characteristics and operative results of patients who underwent hysterectomy via laparotomy (TAH), laparoscopy (TLH) and robotic assistance (TRH)

Pre-Operative Characteristics	TAH (n =138)	TLH (n =81)	TRH (n =103)	*P* value
Age (years)				
Mean	64.0	62.0	61.9	0.06* 0.95†
Std. Dev.	12.8	10.8	10.6	
BMI				
Mean	34.7	29.0	32.9	0.17* 0.0008†
Std. Dev.	9.2	6.5	7.6	
Stage				
IA	37	23	38	--
IB	49	28	41	
IC	13	11	10	
IIA	5	4	1	
IIB	8	0	2	
IIIA/IIIB/IIIC	17	14	10	
IVA/IVB	3	1	0	
Unstaged	6	--	1	

Note. Age; BMI, body mass index; EBL, estimated blood loss; and Stage comparisons based on
*t-tests have been used for all continuous variables comparison of TAH to TRH cohort
†t-tests have been used for all continuous variables comparison of TLH to TRH cohort

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Pre-operative characteristics and operative results of patients who underwent hysterectomy via laparotomy (TAH), laparoscopy (TLH) and robotic assistance (TRH)

Operative Characteristics	TAH (n =138)	TLH (n =81)	TRH (n =103)	*P* value
Total Nodes				
Mean	14.9	23.1	32.9	<0.0001*
Std. Dev	11.3	11.4	26.2	<0.0001†
Total Pelvic Nodes				
Mean	11.5	17.4	20.5	<0.0001*
Std. Dev	8.2	8.9	13.6	0.06†
Total Para-aortic Nodes				
Mean	3.0	6.3	12.0	<0.0001*
Std. Dev	2.9	3.7	9.0	<0.0001†
Operative Time (minutes)				
Mean	146.5	213.4	191.2	<0.0001*
Std. Dev	48.8	34.7	36.0	<0.0001†
EBL (ml)				
Mean	266.0	145.8	74.5	<0.0001*
Std. Dev	184.5	105.6	101.2	<0.0001†
LOS (days)				
Mean	4.4	1.2	1.0	<0.0001*
Std. Dev.	2.0	0.5	0.2	0.001†
Conversion	--	4/81 (4.9%)	3/103 (2.9%)	0.70‡

Note. Total Nodes; Operative time; EBL, estimated blood loss; LOS, length of hospital stay; and conversion postoperatively comparison based on
*t-tests have been used for all continuous variables comparison of TAH to TRH cohort
†t-tests have been used for all continuous variables comparison of TLH to TRH cohort
‡Mantel-Haenszel Chi-square test for discrete variables

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Intra-operative and Post-operative Complications

Complications	TAH (n =138)	TLH (n =81)	TRH (n =103)	*P* value*
Intra-operative Complications				
Caval injury	--	1	--	
Bowel injury	--	1	--	
Enterotomy	1	--	--	
Cystotomy	--	1	--	
Total Intra-operative Complications	1/138 (0.7%)	3/81 (3.7%)	0 (0%)	
Total Post-operative Complications	40/138 (28.9%)	8/81 (9.9%)	5/103 (5.8%)	
Overall complication rate	41/138 (29.7%)	11/81 (13.6%)	6/103 (5.8%)	<0.0001 0.07
Transfusion	2/138 (1.5%)	2/81 (2.5%)	1/103 (1%)	0.81 0.58

*Chi-square test with continuity correction used
Fisher's exact test used for comparison between TAH and TRH transfusion rates (0.81) and comparison between TLH and TRH cohorts (0.58)

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Summary of reports on Hysterectomy with staging completed via **Laparotomy**

Author	N	Pelvic Nodes	Periaortic Nodes	Operative Time (minutes)	EBL (cc)	LOS (days)	Complications N(%)
Eltabbakh 2002	86	7.0	3.5	NR	250.0	5.0	16 (18.6%)
Kuoppala 2004	40	7.3	NA	96.0	238.0	7.6	16 (40%)
Kim 2005	168	23.9		150.5	NR	15.5	30 (17.9%)
Etabbakh 2000	40	5.3	NR	137.7	303.3	5.6	5 (12.5%)
Frigerio 2006	55	17.0	NA	175.0	177.0	8.5	16 (29.1%)
Gil-Moreno 2006	315	11.0	3.6	150.0	400.0	8.0	91 (28.9%)
Boggess 2008 Laparotomy current series	138	11.5	3.0	146.5	266.0	4.4	41 (30.4%)

Note. N, number of patients, EBL, mean estimated blood loss, LOS, mean hospital stay

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Summary of reports on **Laparoscopic** hysterectomy with staging for endometrial cancer

Author	N	Pelvic Nodes	Periaortic Nodes	Operative Time (min)	EBL (cc)	LOS (days)	Complications N(%)	Conversion N(%)
Eltabbakh 2002	100	11.0	2.5	NR	200	2.0	9 (9%)	6 (6%)
Holub 2002	92	19.0		173.8	201	4.1	19 (20.6%)	4/92 (4.2%)
Kuoppala 2004	40	11.1	NR	145.0	171	2.7	16 (40%)	1/40 (2.5%)
Kim 2005*	74	27.4		146.6	NR	10.2	8 (10.8%)	0
Frigerio 2006	55	18.5	NR	220.0	285	4.0	8 (14.5%)	3/55 (5.4%)
Gil-Moreno 2006	55	16.64	7.04	192.0	250	4.0	9 (16.4%)	0
Boggess 2008 Laparoscopic Current Series	81	17.4	6.3	213.4	145	1.2	15/81 (18.5%)	4/81 (4.9%)
Boggess 2008 Robotic Current series	103	20.5	12.0	191.2	74.5	1.0	7/103 (6.8%)	3/104 (2.8%)

*Laparoscopically assisted vaginal hysterectomy
NR= not reported

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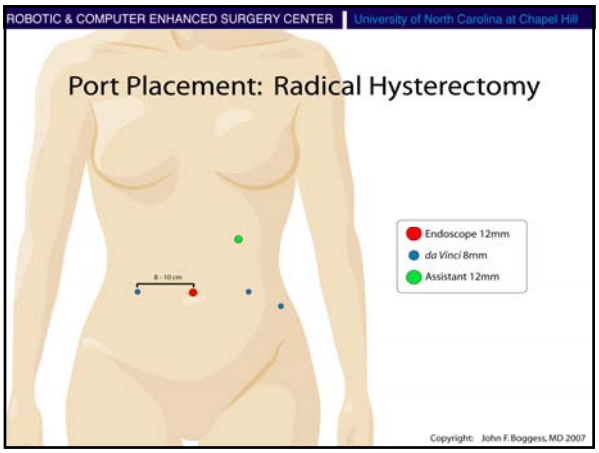
Summary of reports on **Robotic** hysterectomy with staging for endometrial cancer

Author	N	BMI	Nodes	Operative Time (min)	EBL (cc)	LOS (days)	Complications N(%)
Reynolds 2008	4	-------	--------	257	50	2.0	-------
Veljovich 2008	25	27.6	17.5	283	67	1.7	5 (20.%)
Boggess 2008 Robotic Current series	103	32.9	32.9	191.2	74.5	1.0	7/103 (6.8%)



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Characteristics and results of patients who underwent robotic versus open radical hysterectomy and lymphadenectomy

Pre-Operative Characteristics	Robotic (n=51)	Open (n=49)	*P* value
Age (years)			0.029*
Mean	47.4	41.9	
Std. Dev.	± 12.9	± 11.2	
BMI			0.08*
Mean	28.6	26.1	
Std. Dev.	± 7.2	± 5.1	
Uterine Weight (g)			0.64*
Mean	137.8	132.6	
Std. Dev.	± 56.5	± 55.5	
Prior Abdominal Surgery	26/51 (51%)	9/49 (18.4%)	

Note. Age; BMI, body mass index; and Uterine weight comparisons based on
*t-tests have been used for all continuous variables

Characteristics and results of patients who underwent robotic versus open radical hysterectomy and lymphadenectomy

Pathological Characteristics	Robotic (n=51)	Open (n=49)	*P* value
Stage			0.32†
IA1	1	0	
IA2	5	4	
IB1	37	40	
IB2	3	4	
IIA	1	1	
Other	4	0	
Grade			0.51†
1	8	3	
2	19	21	
3	15	23	
Histology			0.51†
Squamous cell carcinoma	32	32	
Adenocarcinoma	18	12	
Adenosquamous	1	4	
Small Cell	--	0	

Note: 9 patients in robotic group missing grade; 2 patients in open group missing grade, 1 patient in open group with unknown histology
†Mantel-Haenszel Chi-square test for discrete variables

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Characteristics and results of patients who underwent robotic versus open radical hysterectomy and lymphadenectomy

Operative Characteristics	Robotic (n=51)	Open (n=49)	*P* value
Total Nodes			0.0003*
Mean	33.8	23.3	
Std. Dev.	± 14.2	± 12.7	
Operative Time (minutes)			0.0002*
Mean	210.9	247.8	
Std. Dev.	± 45.5	± 48.8	
EBL (ml)			<0.0001*
Mean	96.5	416.8	
Std. Dev.	± 85.8	± 188.1	
Transfused (N)	0	4	0.15
LOS (days)			
Mean	1	3.2	<0.0001*
Self Cathing	5/51 (10%)	N/A	

Note:Total Nodes; EBL, estimated blood loss; and LOS, length of hospital stay comparisons based on
*t-tests have been used for all continuous variables

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Complications

Post-Operative Characteristics	Robotic (n=51)	Open (n=49)	*P* value
Post-operative Complications			
Cuff abscess	1	--	
Femoral nerve injury	--	2	
Ileus	--	1	
Lymphocyst	--	1	
Lymphedema	1	--	
Post-op hemorrhage	--	1	
Readmission	1	--	
Vaginal cuff dehiscence	1	1	
Wound infection	--	2	
Overall	4 (7.8%)	8 (16.3%)	0.35*

*Chi-square test with continuity correction used

Summary of reports on **Open** radical hysterectomy and pelvic lymphadenectomy with or without para-aortic lymphadenectomy

Author	N	Total Nodes	Operative Time (minutes)	EBL (ml)	LOS (days)	Complications N(%)
Artman L 1987	153	--	340	1800	--	98 Intra-operative transfusions (64%) 35 Post-operative (22.9%)
Magrina J. 1995	375	--	143	(69) 18% transfused	9.7	89 Overall (24%)
Mirhashemi R 1999	156	--	187.8 – 207	24% transfused	--	53 Overall (33.9%)
Malur 2001	70	10.7	209.9	81.4% transfused	22.8	1 Intra-operative (1.4%)* 59 Post-operative (84.3%)
Abu-RustumN.2003	195	30.7	296	693	9.7	11 Intra-operative (5.6%) 85 Post-operative (43.5%)
Steed H. 2004	205	--	150	500	5	8 Intra-operative (4%) 14 Post-operative (7%)
Boggess J (Current Open Series)	49	23.3	247.8	416.8	3.2	8 Overall (16.3%)

*death due to hemorrhagic shock
N, number of patients, EBL, mean estimated blood loss, LOS, mean hospital stay

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Summary of reports on **Laparoscopic** radical hysterectomy or **laparoscopic assisted radical vaginal** hysterectomy and pelvic lymphadenectomy with or without para-aortic lymphadenectomy

Author	N	Total Nodes	Operative Time (minutes)	EBL (ml)	LOS (days)	Complications N(%)	Conversion N(%)
Querleu D. 2000*	95	Interiliac: 18-19	118 – 175	NR	1.2 – 1.9	11 Post-operative (11.5%)	NR
Renaud M C. 2000†	57	Pelvic: 27 Aortic:3	270	300	5	4 Intra-operative (7%) 5 Post-operative (8.8%)	3.5%
Malur S 2001*	70	Pelvic: 27 Aortic: 7.8	292.9	8.6% transfused	11.4	8 Intra-operative (11.4%) 15 Post-operative (21.4%)	0%
Spirtos N. 2002	78	Overall: 34.1 Pelvic: 10.3 Aortic: 23.8	205	250	2.9	3 Intra-operative (3.9%) 7 Post-operative (9.1%)	5 (6.4%)
Abu-Rustum N. 2003	19	Pelvic: 25.5	295	301	4.5	1 Intra-operative (5.3%) 1 Post-operative (5.3%)	2 (10.5%)
Hertel H. 2003*	200	Pelvic: 22 Aortic: 8	333	19.2% transfused	14	26 Intra-operative (13%) 30 Post-operative (15%)	2 (1%)
Steed H. 2004*	71	--	210	300	1	9 Intra-operative (13%) 10 Post-operative (14%)	0%
Gil-Moreno 2005	27	Pelvic: 19.1	285	400	5	7 (25.9%)	1 (3.7%)
Ramirez P. 2006	20	Pelvic: 13	332.5	200	1	3 Peri-operative (15%) 2 Long-term (10%)	0%
Boggess J (Current robotic series)	51	31.8	210.9	96.5	1	4 Overall (7.8%)	0%

*modified radical vaginal hysterectomy with or without laparoscopic nerve-sparing dissection
†Vaginal Radical Hysterectomy with laparoscopic pelvic lymphadenectomy
NR= not reported

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Summary of reports on **Robotic** radical hysterectomy for cervical cancer

Author	N	Stage	BMI	OR Time	Nodes	EBL
Marchal 2005	5	-----	-----	-----	-----	-----
Sert 2006	1	IB1	-----	-----	-----	-----
Sert 2007	7	-----	24.6	241	-----	71
Kim 2007	10	IA2 - IB1	26	207	27.6	355
Magrina 2008	27	IA2 - IB2	26	190	25.9	133
Fanning 2008	20	IB1 - IIA	----	390	18	300
Boggess 2008 Robotic Current series	51	IA1 - IIA	28.5	211	33.8	96.5

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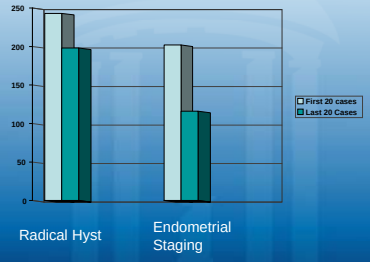
Robotic Surgery Learning Curve



Radical Hyst

Endometrial Staging

Single Surgeon Experience

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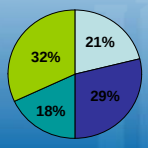
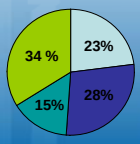
Learning Curve for Endometrial Cancer Staging

First 20 Cases



Time 202

Second 20 Cases



Time 116

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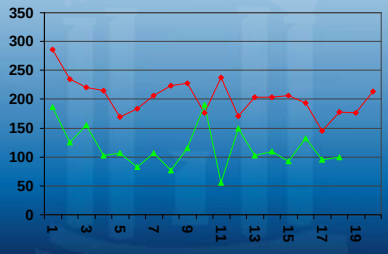
Robotic Surgery Learning Curve: Endometrial Cancer Staging



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Learning Curve for Radical Hysterectomy: Single Surgeon

Time 243

Time 198

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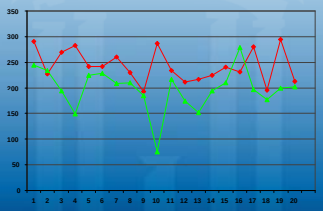
Robotic Surgery Learning Curve: Radical Hysterectomy



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Conclusions

- Reproducible procedures for cervix and endometrial cancer.
- Superior outcomes to open, laparoscopy techniques.
- Technique of choice
- Teachable to fellows and residents
- Simplification