

Surgical Performance as a Predictor of Functional and Oncological Outcomes in Robotic Prostatectomy

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 @mitchgoldenberg



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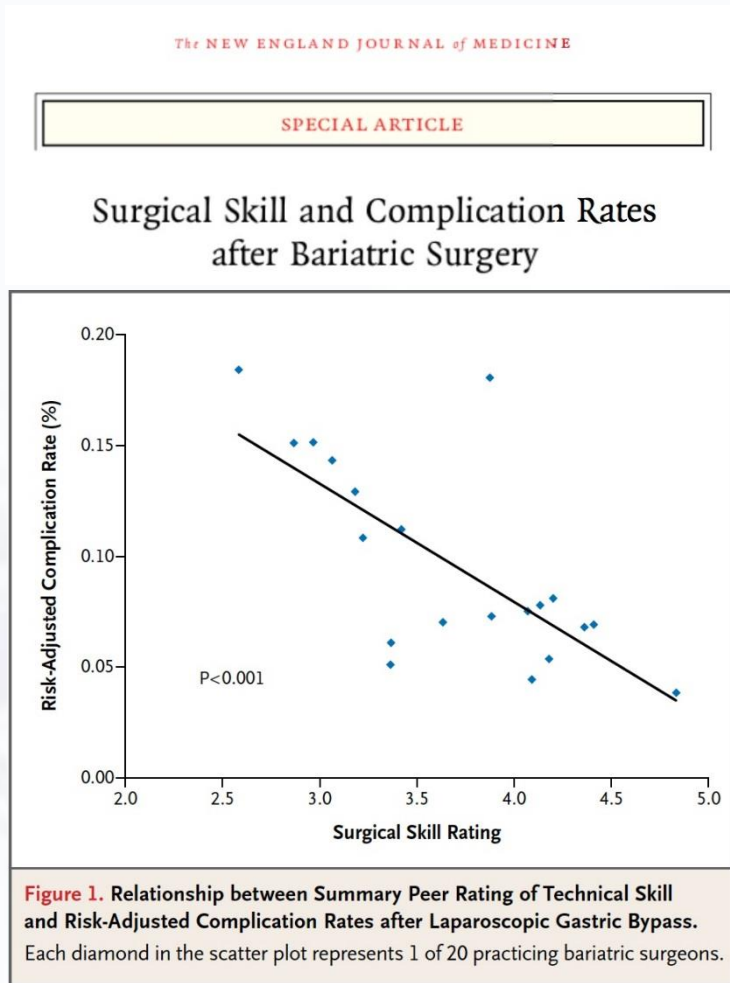
Division of Urology

Potential Conflict of Interest Disclosure

Speaker Name	Advisory Boards	Speaker's Bureau	Payment/Honoraria	Grants/Research Support	Clinical Trials	Investments	Patents
Mitchell Goldenberg	Surgical Safety Technologies		Surgical Safety Technologies	1. Royal College of Physicians and Surgeons of Canada 2. Canadian Urological Oncology Group			



Is *Technical Performance* a Quality Indicator?



Surgeon Performance Predicts Early Continence After Robot-Assisted Radical Prostatectomy

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Retrospective Matched Cohort of 48 Men Undergoing RARP

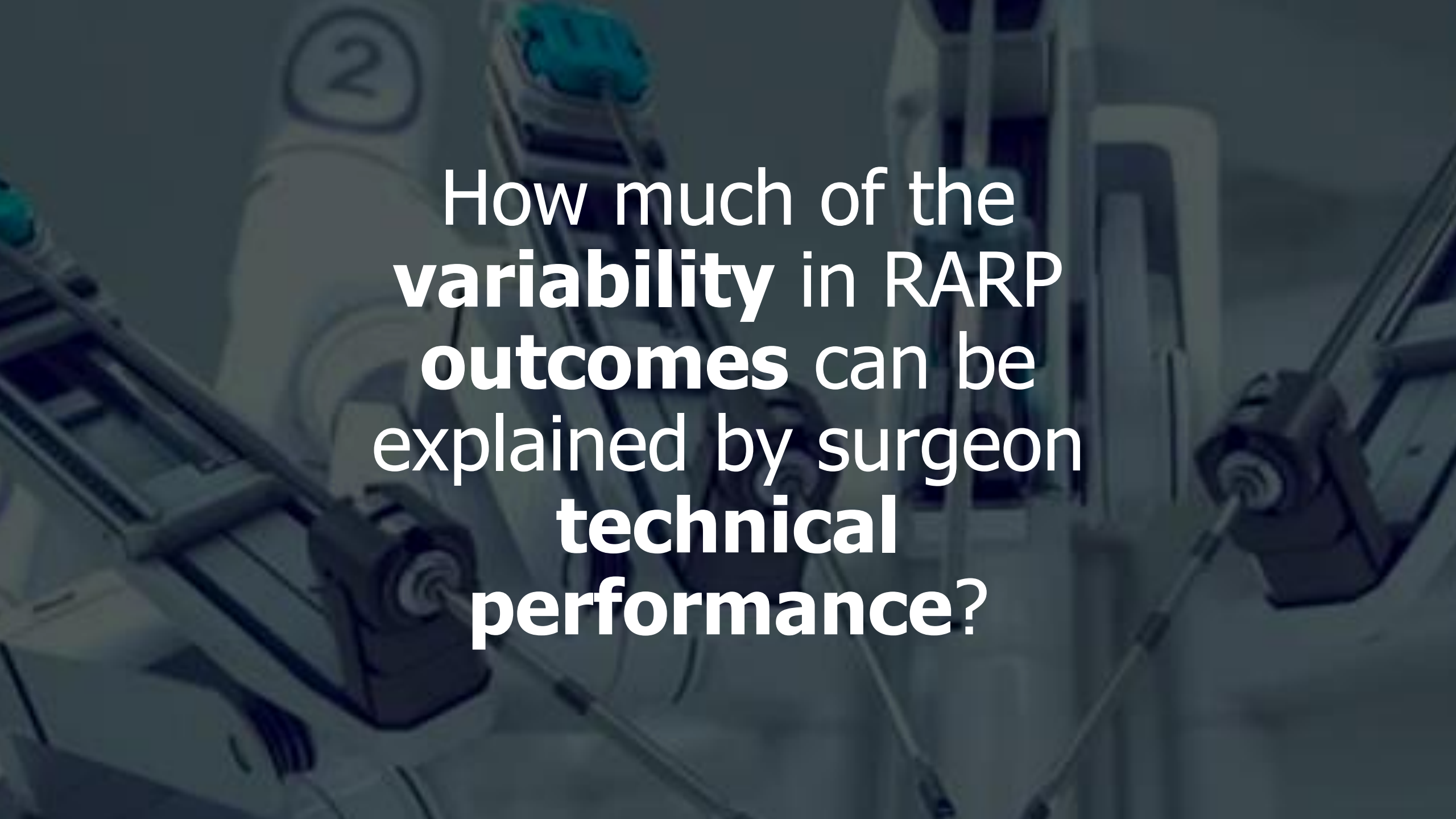


Video analyzed for GEARs Score and Surgical Errors



GEARS score significantly associated with early continence






How much of the **variability** in RARP **outcomes** can be explained by surgeon **technical performance**?

Implementing assessments of robot-assisted technical skill in urological education: a systematic review and synthesis of the validity evidence

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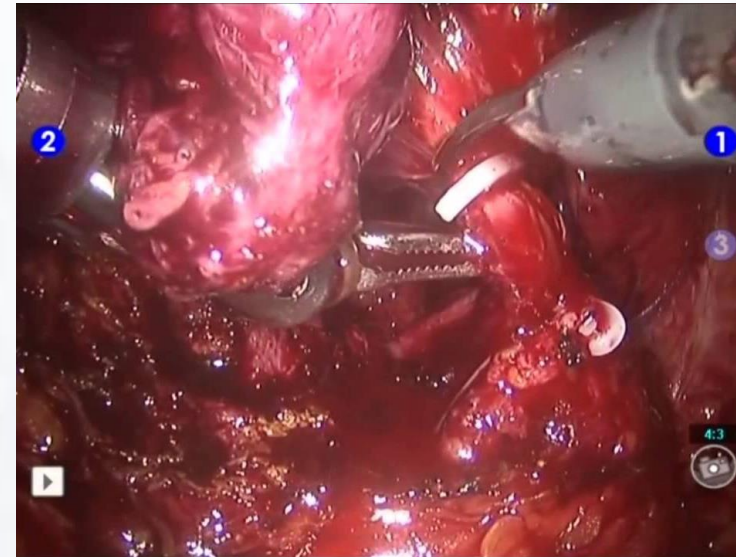
Mitchell G. Goldenberg^{*} , Jason Y. Lee^{*}, Jethro C.C. Kwong[†], Teodor P. Grantcharov[‡] and Anthony Costello[§]

Gold standard = *Global Rating Scales*

Generic = *GEARS*

Procedure-Specific = *PACE*

Force Sensitivity
Depth Perception
Bimanual Dexterity
Robotic Control
Efficiency



GEARS – Global Evaluative Assessment of Robotic Skills

Depth perception

1	2	3	4	5
Constantly overshoots target, wide swings, slow to correct		Some overshooting or missing of target, but quick to correct		Accurately directs instruments in the correct plane to target

Bimanual dexterity

1	2	3	4	5
Uses only one hand, ignores nondominant hand, poor coordination		Uses both hands, but does not optimize interaction between hands		Expertly uses both hands in a complementary way to provide best exposure

Efficiency

1	2	3	4	5
Inefficient efforts; many uncertain movements; constantly changing focus or persisting without progress		Slow, but planned movements are reasonably organized		Confident, efficient and safe conduct, maintains focus on task, fluid progression

Force sensitivity

1	2	3	4	5
Rough moves, tears tissue, injures nearby structures, poor control, frequent suture breakage		Handles tissues reasonably well, minor trauma to adjacent tissue, rare suture breakage		Applies appropriate tension, negligible injury to adjacent structures, no suture breakage

Robotic control

1	2	3	4	5
Consistently does not optimize view, hand position, or repeated collisions even with guidance		View is sometimes not optimal. Occasionally needs to relocate arms. Occasional collisions and obstruction of assistant.		Controls camera and hand position optimally and independently. Minimal collisions or obstruction of assistant

PACE - Prostatectomy Assessment and Competency Evaluation

DOMAINS*	1	2	3	4	5
Bladder Drop					
Identify and Dissect away from Umbilical Ligaments & Pubic Bone	• Injury to the Bladder/Pelvic Side Wall and/or adjacent Obturator Vessels/Nerve		• Entry into Peri-vesical Fat; or Bleeding Obscuring the Operative Field; or Inadequate Lateral Dissection and/or Curtain of Tissue left anteriorly		• Clean Dissection that respects all Surgical Planes with Minimal /no Bleeding and Preservation of Accessory Vessels if present
Preparation of the Prostate					
Defatting Prostate with Dorsal Venous Complex (DVC) Preservation	• DVC and/or Periprostatic Bleeding • Inadequate Defatting/Injury of Anterior Prostate-Vesical Junction • Untimely and/or Inadvertent Opening of Endopelvic Fascia • Bladder not released from Pelvic Side Wall		• Suboptimal Hemostasis • Inadequate Anterior Prostate-Vesical Exposure with Acceptable Bladder release from Pelvic Side Wall		• Adequate Prostate-Vesical Exposure with Minimal/no Bleeding • Appropriate and Planned Opening of Endopelvic Fascia • Bladder released from Pelvic Side Wall
Bladder Neck Dissection					
Dissection of the Bladder Neck from the Prostate	• Wrong Plane with Subsequent Entry into the Prostate and/or weak (thin) Posterior Bladder Neck • Injury or close proximity to the Ureteric Orifices or Trigone • Leaves Prostate Tissue on the Bladder		• Disproportionate Bladder Neck • Deviates from Prostate-Vesical Junction but returns to the Correct Plane		• Identifies and divides the Natural Groove which delineates the Prostate-Vesical Junction • Proportionate Bladder Neck with adequate thickness and without entry into the Prostate
Dissection of the Seminal vesicles (SV) and Posterior Anatomical Plane					
Dissection of Seminal Vesicles (SV)	• Unintentional Retained Portion of SV • Excessive Use of Cautery • Uncontrolled bleeding from vessels around SV		• Complete Removal of the SV despite Inadvertent Entry • Vessels Torn with subsequent Control of Bleeding		• Complete Atraumatic Removal of SV with Minimal Traction • Appropriate Use of Cautery
Development of Posterior Anatomical Plane	• Entry into the Base of the Prostate • Inappropriate use of Cautery • Rectal injury		• Initial Entry into Suboptimal Plane close to the Prostate or Rectum with subsequent Correction of the Anatomical Plane		• Anatomical Plane created down to the Posterior Urethra with Minimal Bleeding and Tearing of Tissue
Preservation of Neurovascular Bundle (NVB)					
Neurovascular Bundle (NVB) Preservation	• Entry into the Prostate • Inappropriate Use of Cautery • Damage to the Main Trunk of the NVB		• Excessive Traction on/around NVB • Poor Set up/Visualization of Operative Field • Excessive Bleeding • Inadequate Release of NVB at/ adjacent to Apex of the Prostate		• Balanced Hemostasis with Proper Dissection up to and beyond the Apex of Prostate and Urethra • Appropriate Use of Cautery
Apical Dissection					
Apical Dissection	• Entry into the Apex of Prostate with Remnants of Prostate Tissue left on the Urethra • Untimely Entry into the DVC • Excessive Traction and injury/shortening of the Urethra • Injury to the Lateral Apical NVB		• Unable to clearly separate Prostatic Apex from the Urethra • Inadequate Closure of the Dorsal Venous Sinuses with Persistent Bleeding • Uneven edges of the urethral incision		• Complete Control of Dorsal Venous Sinuses with Adequate Urethral Length and Preservation of the NVB
Urethro-Vesical anastomosis					
Needle Entry	• Needle Tip usually (>75%) enters Non-Perpendicular		• Needle Tip usually enters half the time Non-Perpendicular		• Needle Tip usually (>90%) enters Perpendicular
Needle Driving & Tissue Trauma	• Wrist Rotation seen <25% times with Tissue Trauma		• Wrist Rotation seen <50% times with Minimal Tissue Trauma		• Wrist Rotation almost always (>90%) seen with no Tissue Trauma
Urethro-Vesical Approximation	• Poor Approximation of Posterior Plate • Significant Leakage after Irrigation requiring Re-anastomosis		• <50% of Circumferential Approximation • Minor Leakage after Irrigation requiring Repair		• Well Approximated • Water Tight after Irrigation



Multicenter Prospective Cohort Study



Intracorporeal Video Collected from consecutive RARP Cases



3 Content Expert, Trained Analysts



Surgical Steps Scored using GEARS and PACE



Three Primary Outcomes Selected



Erections @ 12m



Continence @ 3m



PSM





31 Surgeons Completed ≥ 1 Step
(11 Faculty, 14 Fellows, 6 Residents)

	N	%
Surgeon RARP Experience		
<30 cases	4	4.3
30-100	19	20.7
101-250	25	27.2
>250	44	47.8
Trainee RARP Experience		
<10 cases	13	68.4
10-30 cases	4	21.1
>30 cases	2	10.5

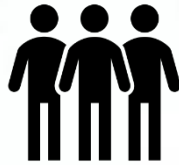




92 Patients Included in Final Analysis

	Mean/Median	SD/IQR
Age	61.2 mean	6.93
BMI	27.1	4.4
PSA	7.0	4.8-10.5
Prostate Volume	46.6	17.0
Blood Loss	250	138
Days to Catheter Removal	13.5	3
Total OR Time	180	74

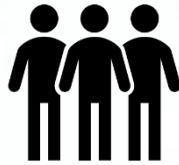




92 Patients Included in Final Analysis

	No	%
Nerve Spare		
No	15	16.3
Yes	76	82.6
Missing	1	1.1
Length of Stay		
1	47	51.1
2	36	39.1
≥3	9	9.8
Blood Transfusion		
No	87	94.6
Yes	1	1.1
Missing	4	4.3
Readmission		
No	78	84.8
Yes	10	10.9
Missing	4	4.3





92 Patients Included in Final Analysis

	No	%
Incontinence		
No	54	58.7
Yes	38	41.3
Erectile Dysfunction		
No	42	45.7
Yes	50	54.3
Gleason Grade		
6	9	9.8
7	72	78.2
≥8	11	12.0
Stage		
≤T2b	19	20.6
T2c	41	44.6
≥T3	31	33.7
Missing	1	1.1
Surgical Margins		
pT2 (n=60)	47	78.3
Negative	13	21.7
Positive		
T3 (n=31)	16	51.7
Negative	15	48.3
Positive		



Steps Associated



Overall PACE Scores Significantly Higher in Patients with Erectile Function at 1 Year ($p = 0.03$)

Overall Only



Bivariate Analysis



Overall GEARS and PACE Scores Significantly Higher in Continent Patients ($p < 0.01$)

Bladder Neck
NVB
Apical Dissection
UVA



Overall PACE Scores Significantly Higher in Patients with Negative Margins ($p = 0.02$)

Bladder Drop
Seminal Vesicles
Posterior
Dissection
Apical Dissection



Continenence and Overall GEARS Score



Multivariable Analysis

Overall GEARS
Age
Nerve-Spare
Volume
BMI
Posterior Reconstruction

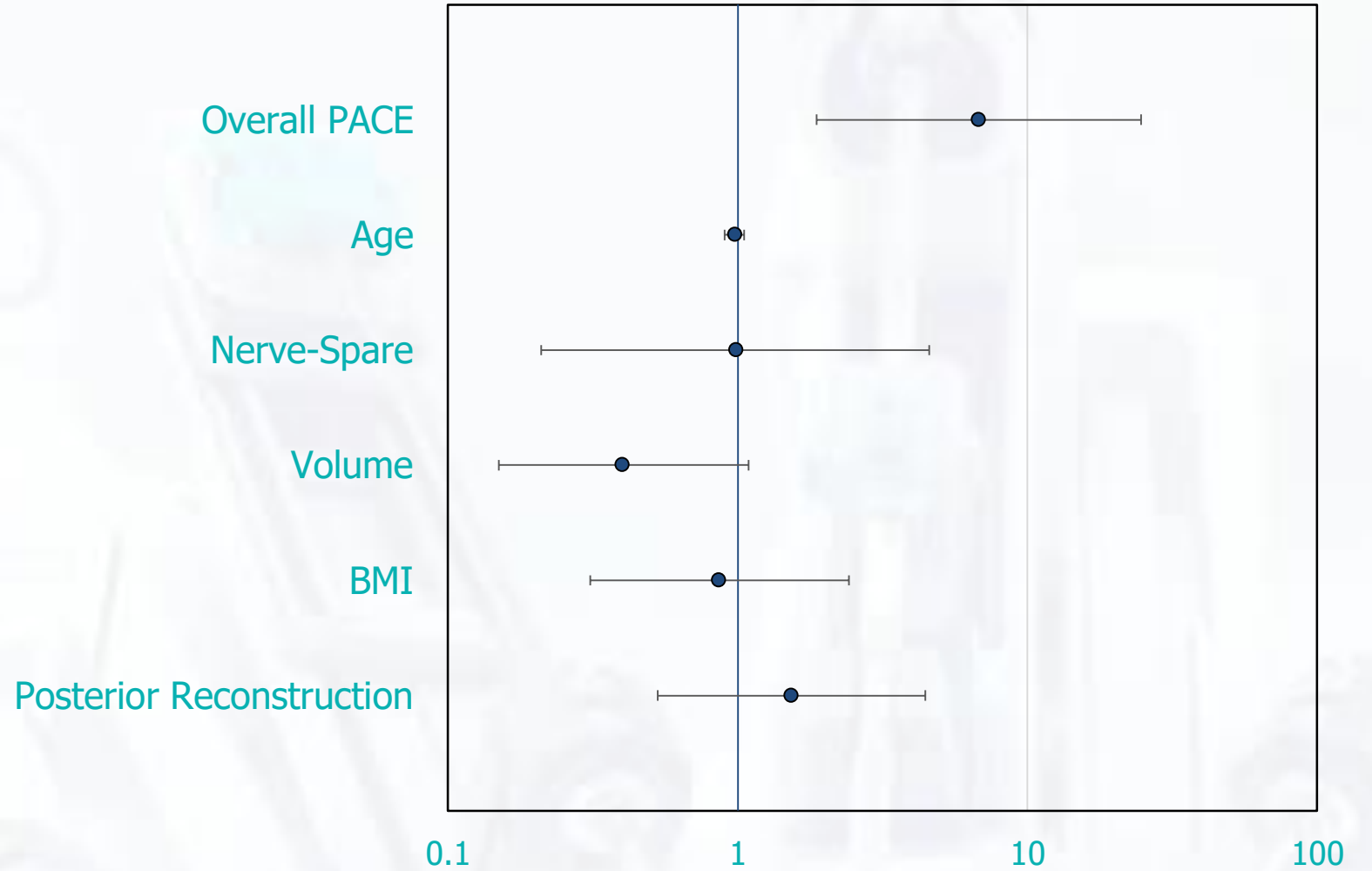


0.1 1 10 100

Continence and Overall PACE Score



Multivariable Analysis



Erectile Function and Overall PACE Score



Multivariable Analysis

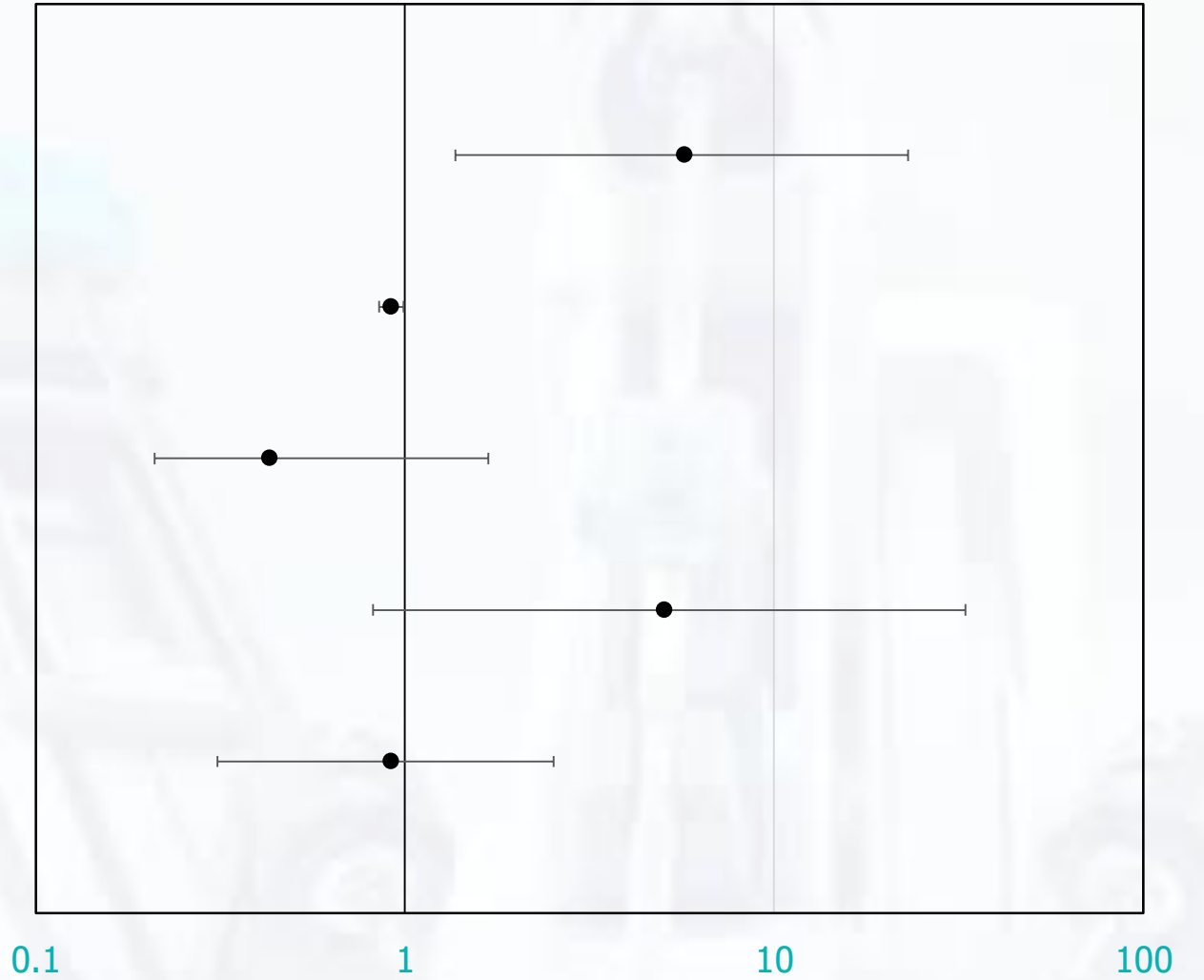
Overall PACE

Age

Nerve-Spare

Volume

BMI

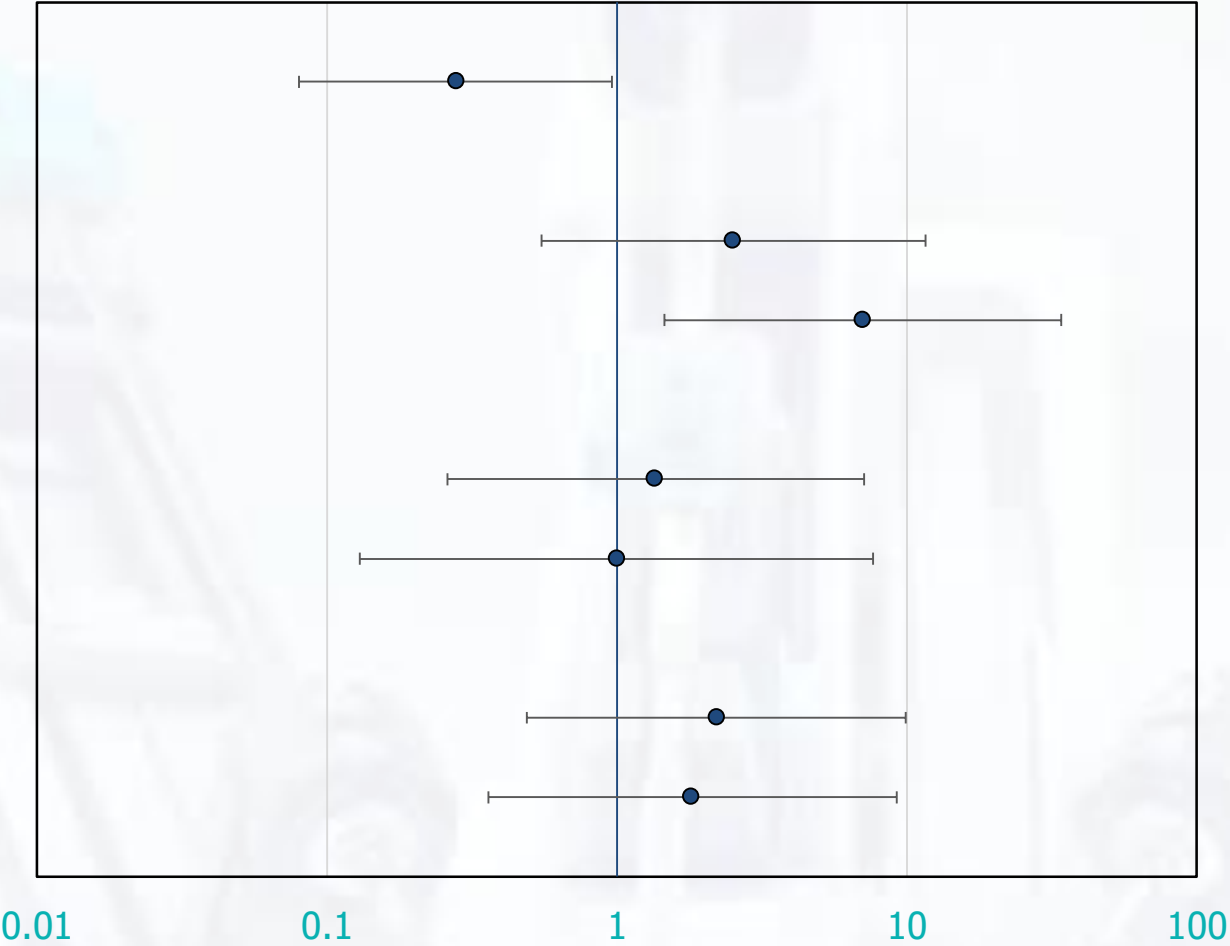


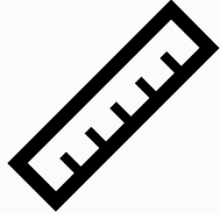
Positive Surgical Margin Overall PACE Score



Multivariable Analysis

- Overall PACE
- ≤ pT2b
- pT2c
- ≥ pT3a
- Gleason 6
- Gleason 7
- ≥ Gleason 8
- PSA < 4.5
- PSA 4.5-8.9
- PSA ≥ 9





Sensitivity Analysis

Included Surgeon Experience and Hospital Volume as Categorical Variables in the Model

- ✓ PACE Remained Independently Predictive of Continence ($p < 0.02$) and PSM ($p = 0.02$)
- ✗ PACE No Longer Predictive of Erectile Function ($p = 0.13$)
GEARS No Longer Predictive of Continence ($p > 0.05$)



Model Validation

K-Fold Validation done with 10-folds



AUC of the Continence Model Stable at 0.74



AUC of Positive Margin Model Fell from 0.73 to 0.52



Key Findings

- ✓ Among first studies to show that surgeon technical skill associated with outcomes in RARP
- ✓ Technical Skill Can be Incorporated into High Stakes Assessments
In-Training/Credentialing
- ✓ Provides Key Validity Evidence for the Assessment Tools Used
- ✓ Possibility for surgeon skill/performance as a reliable quality indicator



Thanks For Listening!

- Co-Authors
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St. Michael's

Inspired Care.
Inspiring Science.

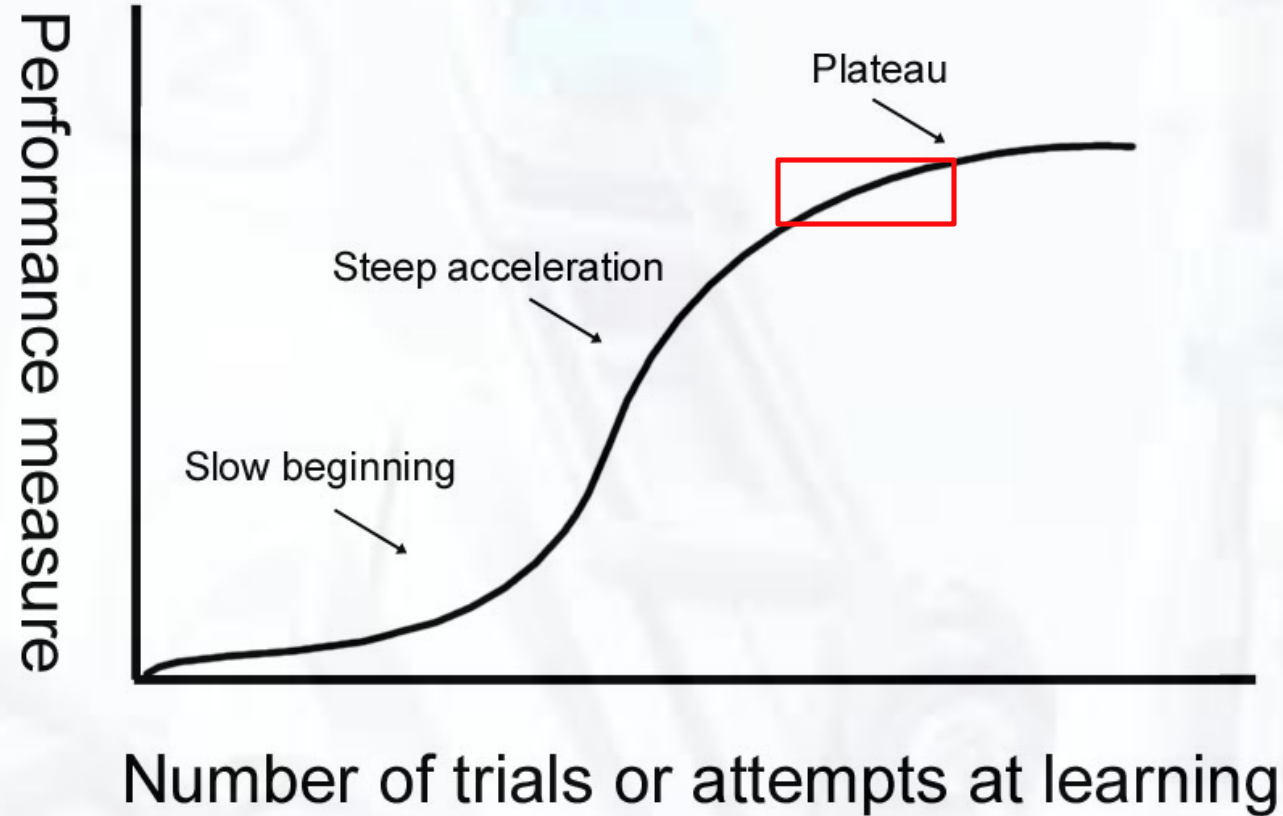


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Extra Slides



Skill vs. Performance

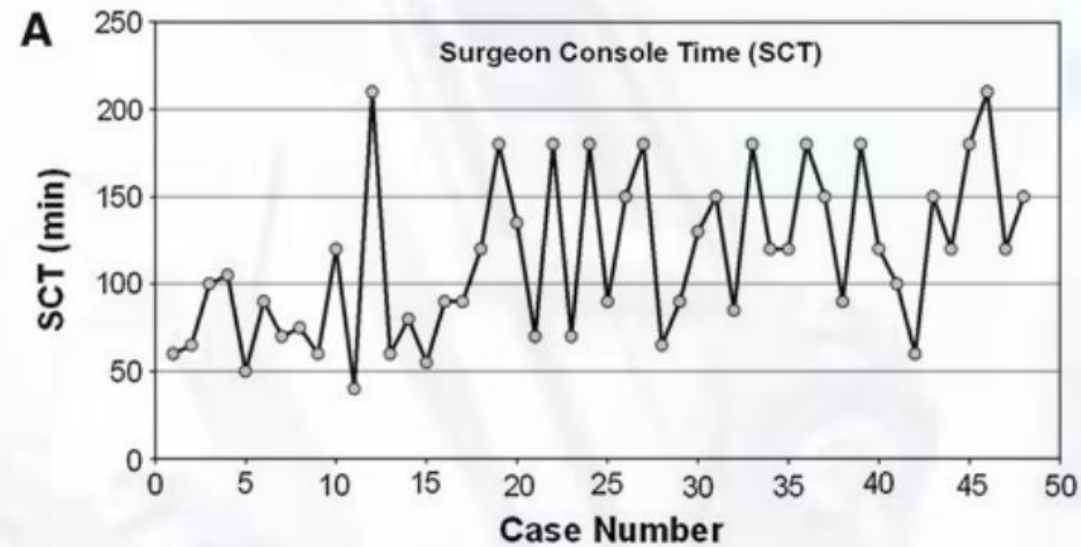


Skill vs. Performance

Learning curve for robotic-assisted laparoscopic colorectal surgery

Surg Endosc (2011) 25:855–860
DOI 10.1007/s00464-010-1281-x

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Statistical Analysis



Primary Outcomes
Dicotomized



68 patients subjects needed
(90% power, $p < 0.05$)



Binary Logistic Regression



Sensitivity Analysis
(Surgeon, Hospital Effects)



K-Fold Cross-Validation

