Parturition and the Pelvic Floor

ACOG

August 2016

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University of Michigan Pelvic Floor Research Group

"Improving prevention and treatment of women's pelvic floor disorders"

Gynecologists, Engineers, Nurses, Urologists, Physical Therapists, Physiologists, Midwives, Radiologists, Physiatrists, Statisticians, Epidemiologists, Health Services Researchers, Economists, Endocrinologists, Cell Biologists, Veterinarians

Funded by the NIH *(ORWH & NICHD)*

Conflicts of Interest

- Research funding and consulting from AMS
- Royalties: UpToDate, Springer-Verlag

Objectives

- Review relationship of birth to pelvic organ prolapse.
- Define risks “complex vaginal deliveries” and relationship to levator ani injury.
- Discuss disease prevention and recovery models for birth injuries.

Prevention/Recovery

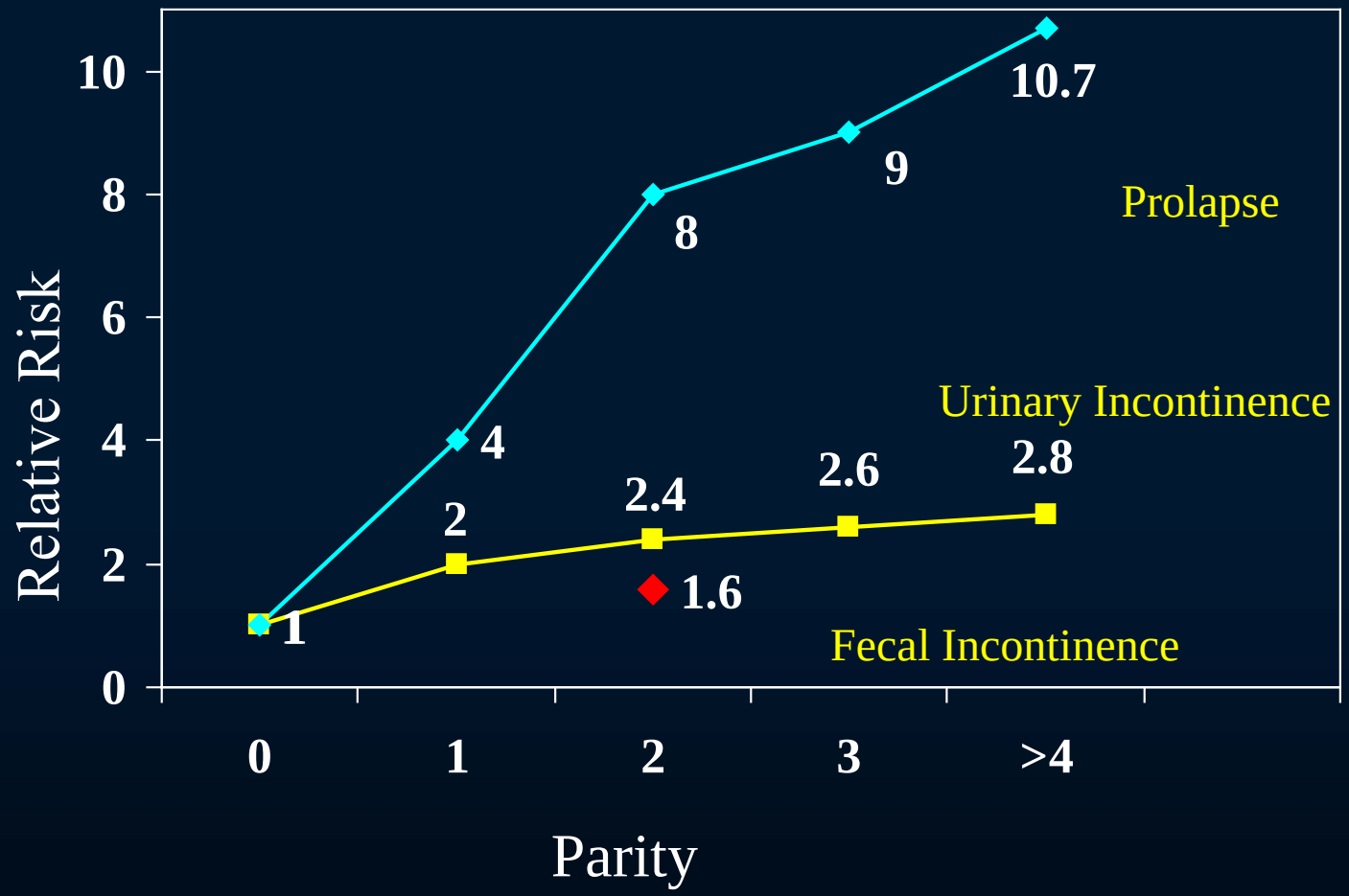
- Epidemiology
- Disease Model
- Risk vs. Benefit of Intervention
- Natural history of healing

Prevention/Recovery

- Epidemiology
- Disease Model
- Risk vs. Benefit of Intervention
- Natural history of healing

Vaginal Parity and Relative Risk of Prolapse and Urinary Incontinence

Mant J. Br J Obstet Gynecol 1997;104:579
Rortveit G et al. NEJM 2003;348:900



Disease Prevention

Prolapse is the biggest problem

Vaginal birth is the biggest opportunity.

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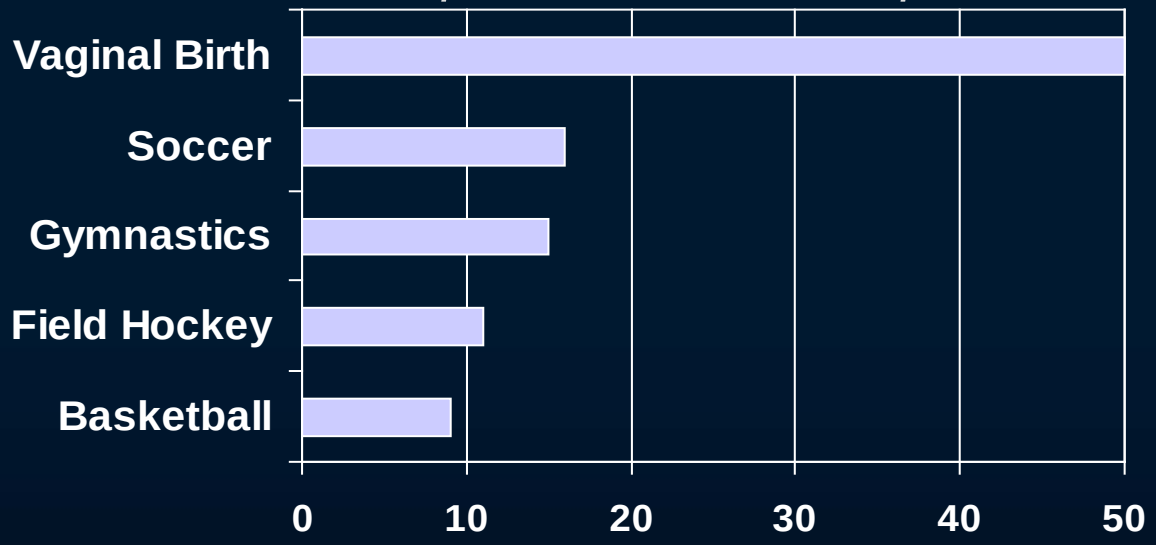
Injury Rates for Athletics and Vaginal Birth

per 1,000 Hours Exposure



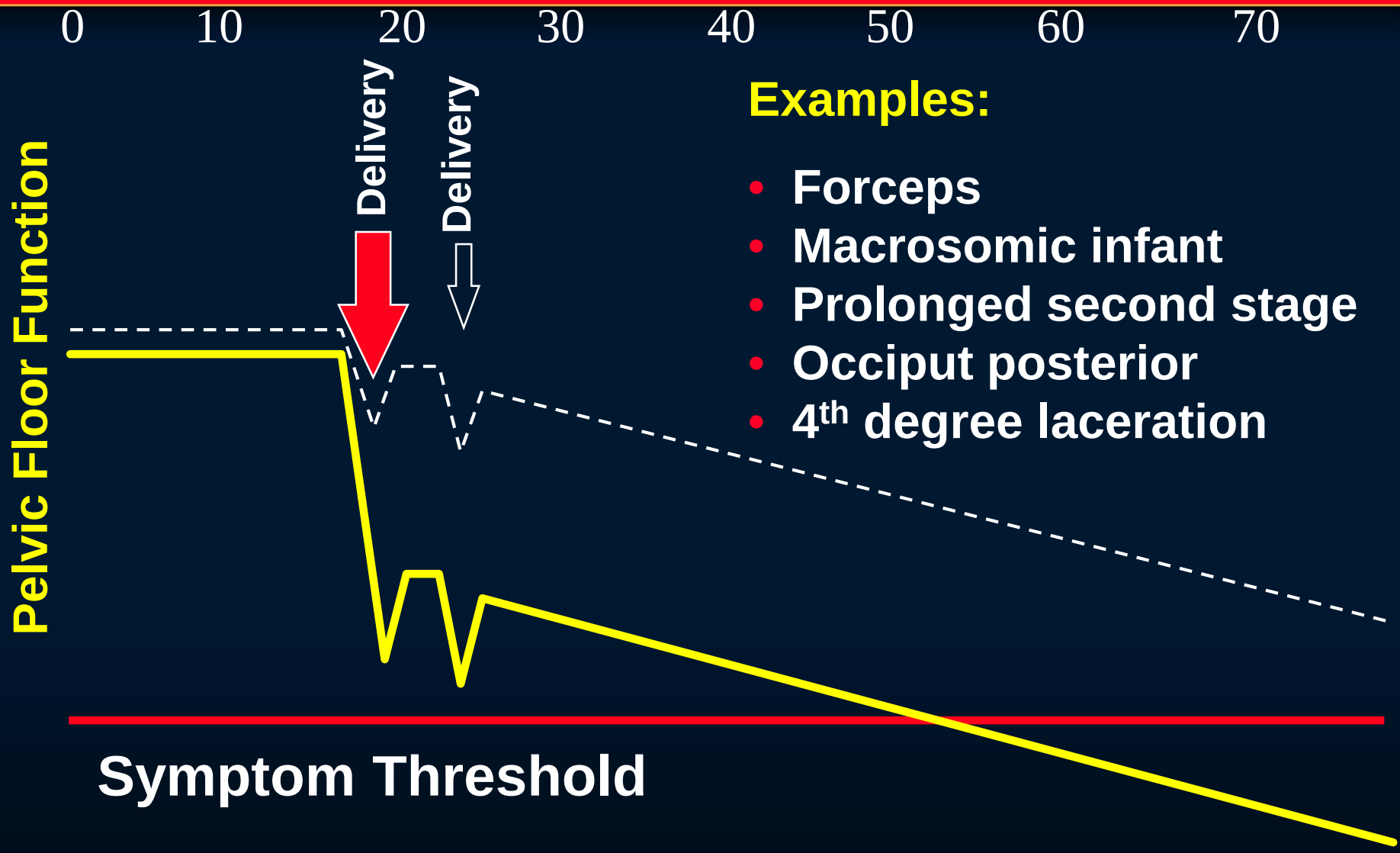
- Diagnosis
- Treatment
- Rehab
- Prevention

*2006 NCAA Data &
Kearney, *Obstet Gynecology 2006;107:144-9*

Prevention/Recovery

- Epidemiology
- Disease Model
- Risk vs. Benefit of Intervention
- Natural history of healing

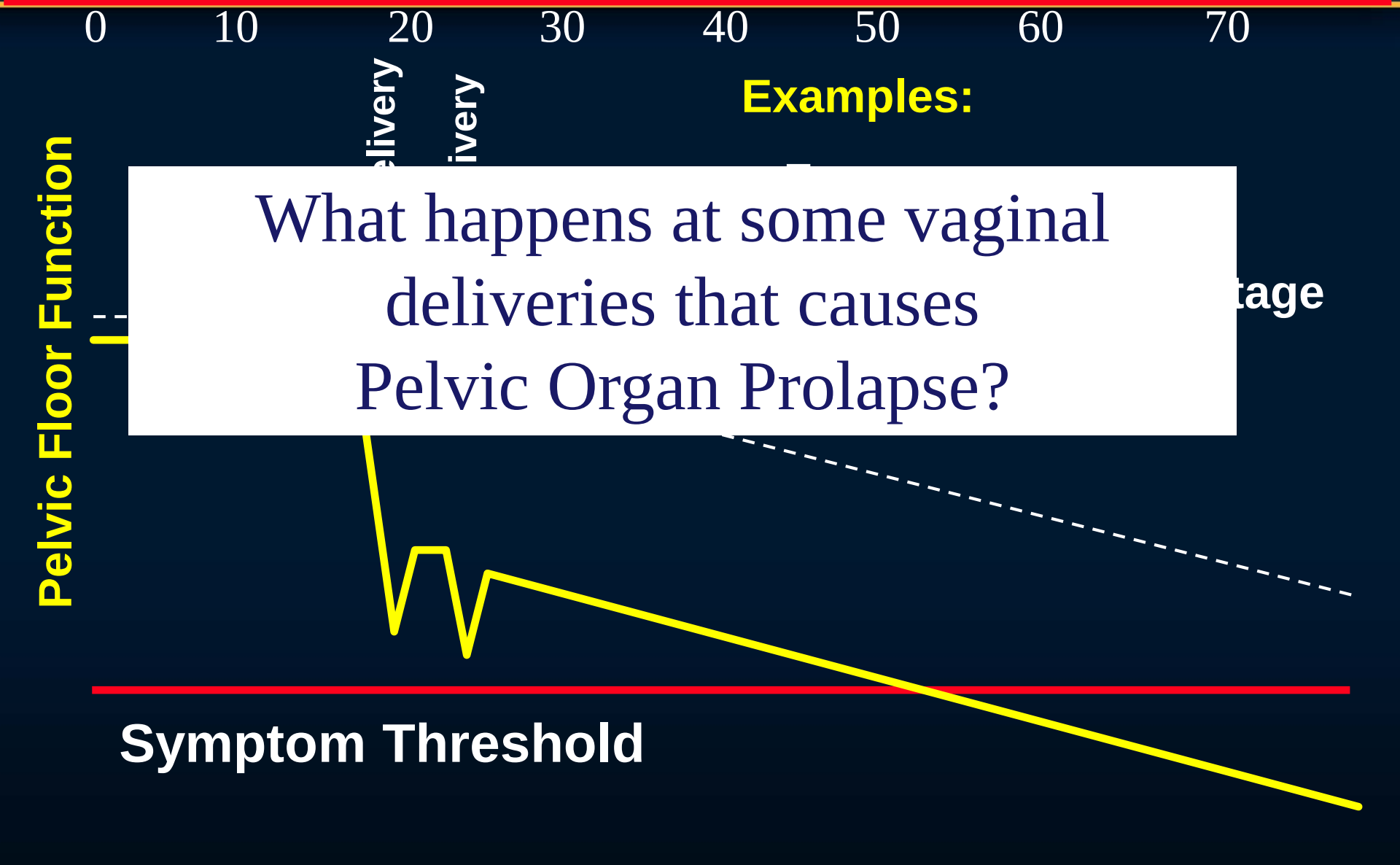
Disease Model



Examples:

- **Forceps**
- **Macrosomic infant**
- **Prolonged second stage**
- **Occiput posterior**
- **4th degree laceration**

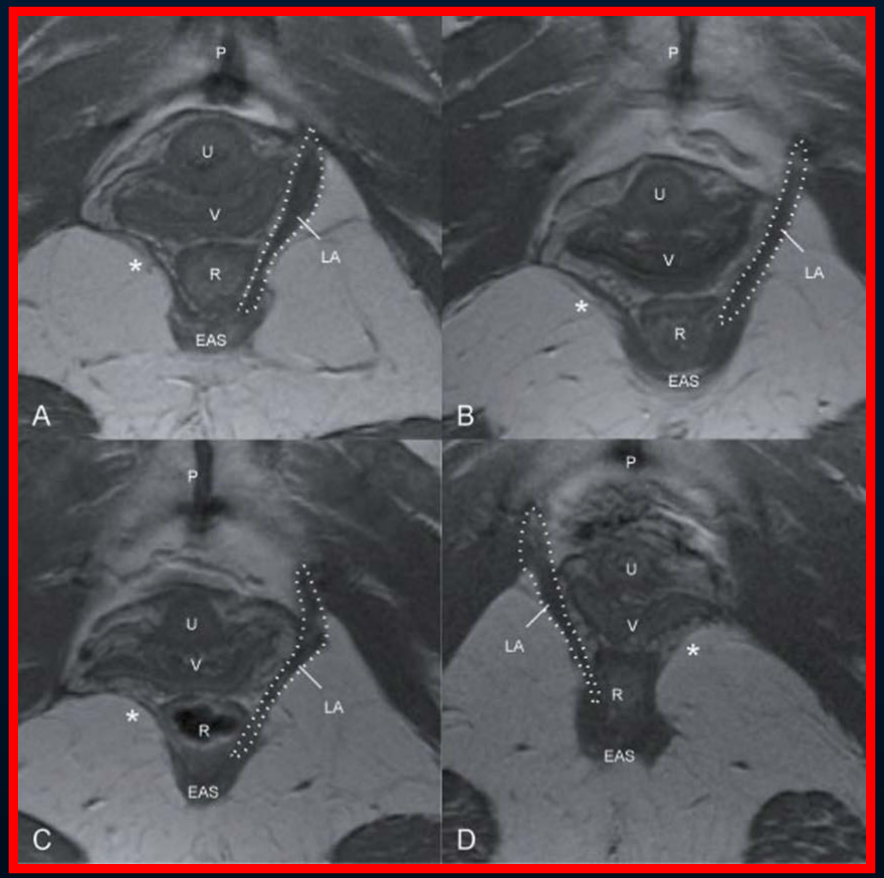
Disease Model



The Appearance of Levator Ani Muscle Abnormalities in Magnetic Resonance Images After Vaginal Delivery

John O. L. DeLancey, MD, **Rohna Kearney, MRCOG**, **Queena Chou, MD**, **Steven Speights, MD**, and **Shereen Binno, MD**

From the University of Michigan, Ann Arbor, Michigan.



- Abnormalities of the levator ani in parous women
- 20% of primiparas had defects
- No defects noted in nulliparas

Levator Ani Damage on MRI

Defect after first birth

Obstet Gynecol 2003;101:46

80 primiparous stress incontinent women

80 primiparous continent women

9 months after delivery

- **1 in 10** women had major damage to the levator ani muscle
- 90% involved pubic origin
- Twice as many levator defects were in the stress incontinent group as the controls

Women with levator ani defects

- They have second stages that are 1 hour longer
- They are 3 times more likely to have been delivered by operative means
- They are four times more likely to have had a sphincter rupture.
- They are twice as likely to have a cystocele

Obstetrical Factors and LA Injury

Kearney, *Obstet Gynecol 2006;107:144-9*

	No LA Defect (n=131)	LA Defect (n=29)	Odds Ratio	P
Ruptured Sphincter	16.8%	62.1%	8.1	.001
Forceps	4.6%	41.4%	14.7	.001
Vacuum	7.6%	6.9%	0.9	.626
Episiotomy	34.4%	62.1%	3.1	.006
Epidural	68.7%	65.5%	0.9	.448

OB Factors and Levator Injury

Shek & Dietz BJOG 2010;117:1485–1492

	Avulsion (n = 32)	No avulsion (n = 208)	Odds ratio on univariable regression	Odds ratio on multivariable regression
Epidural	34%	35%	0.96 (CI 0.4–2.1)	
Occipito-posterior	13%	3%	5.05 (CI 1.34–19.1)	3.86 (CI 0.95–15.7)
Forceps delivery	22%	6%	4.2 (CI 1.53–11.5)	3.83 (CI 1.34–10.94)
Episiotomy	41%	23%	2.34 (CI 1.08–5.1)	
Vacuum delivery	9%	15%	0.59 (CI 0.17–2.06)	
Birthweight (g)	3561	3460	1.0 (CI 1.0–1.0)	
Length of second stage	94	68	1.01 (CI 1.0–1.01)	
Head circumference (cm)	34.5	34.5	0.99 (CI 0.75–1.30)	

Levator Ani Muscle Stretch Induced by Simulated Vaginal Birth

Obstetric and Gynecology 2004;104:31-40

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Kuo-Cheng Lien, MS

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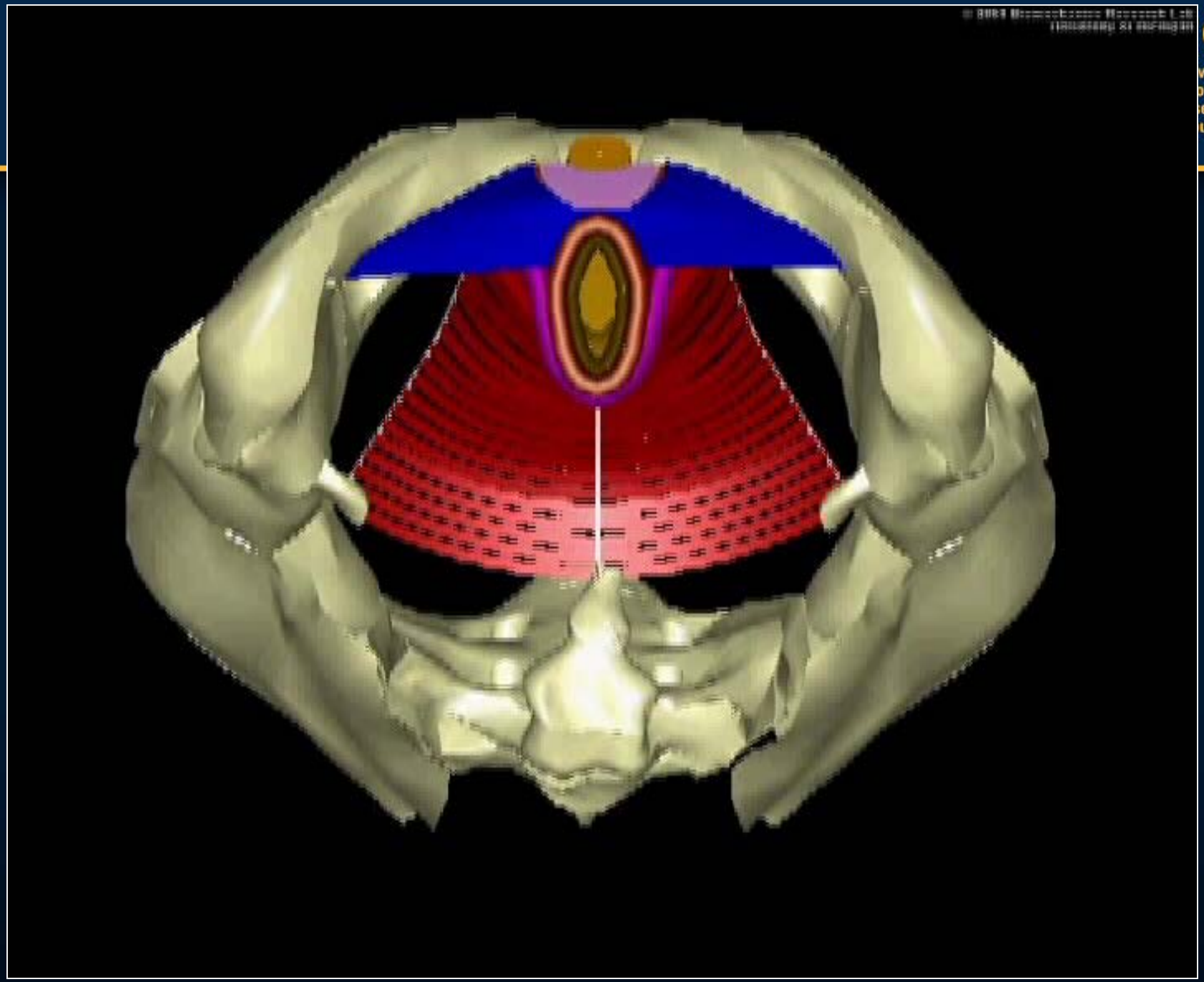
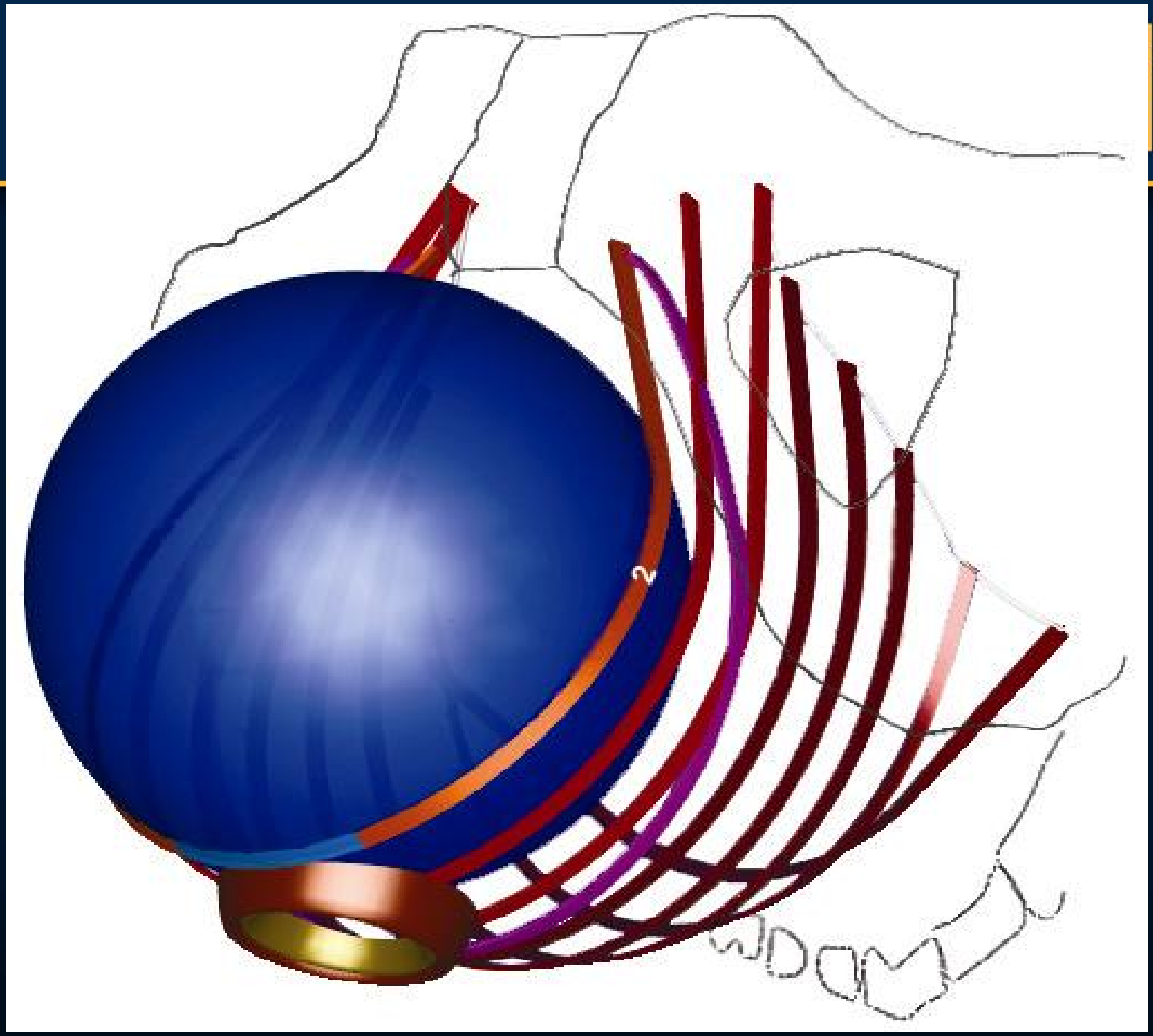
John O.L. DeLancey, M.D.

Dee E. Fenner, M.D.

James Ashton-Miller, PhD





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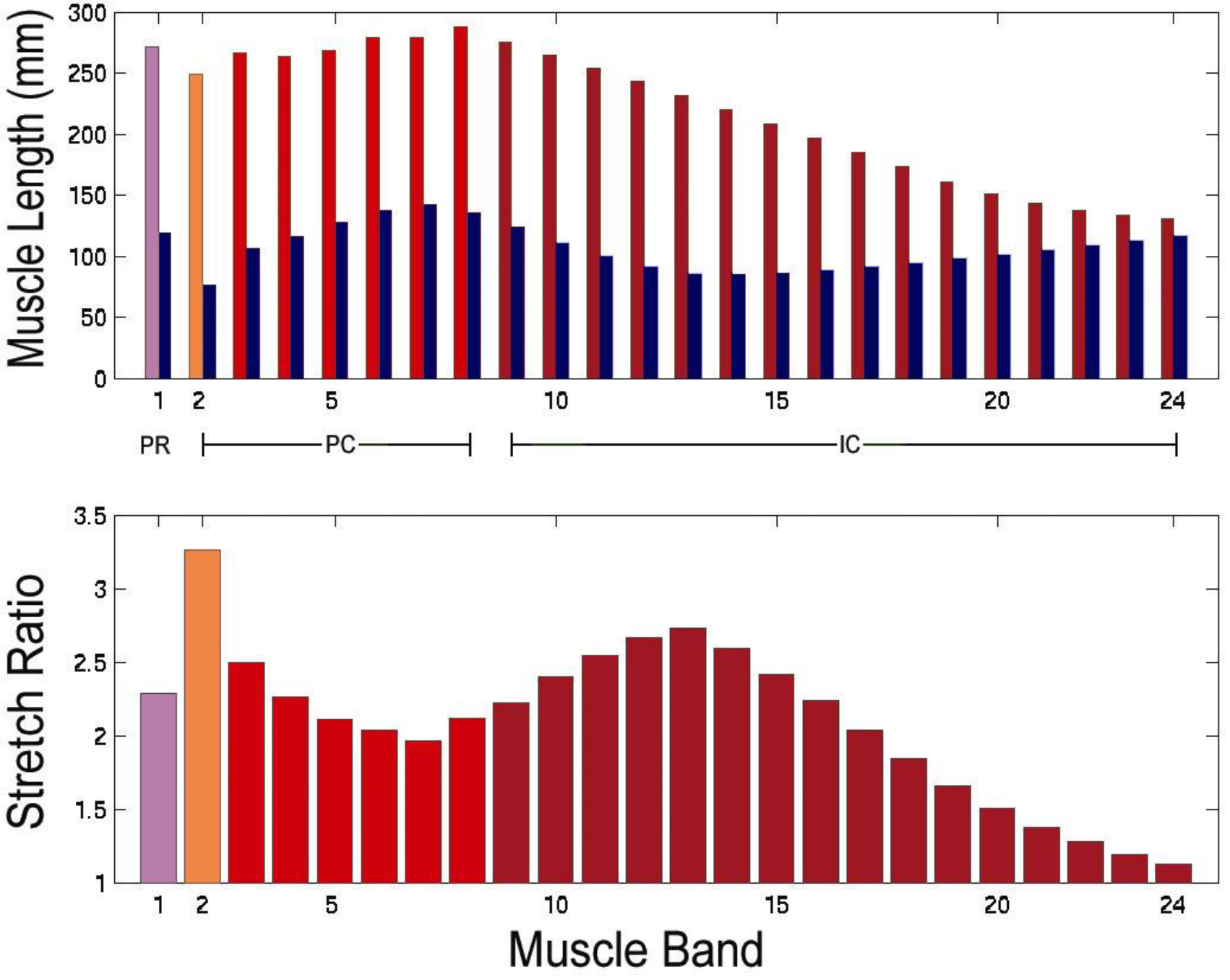
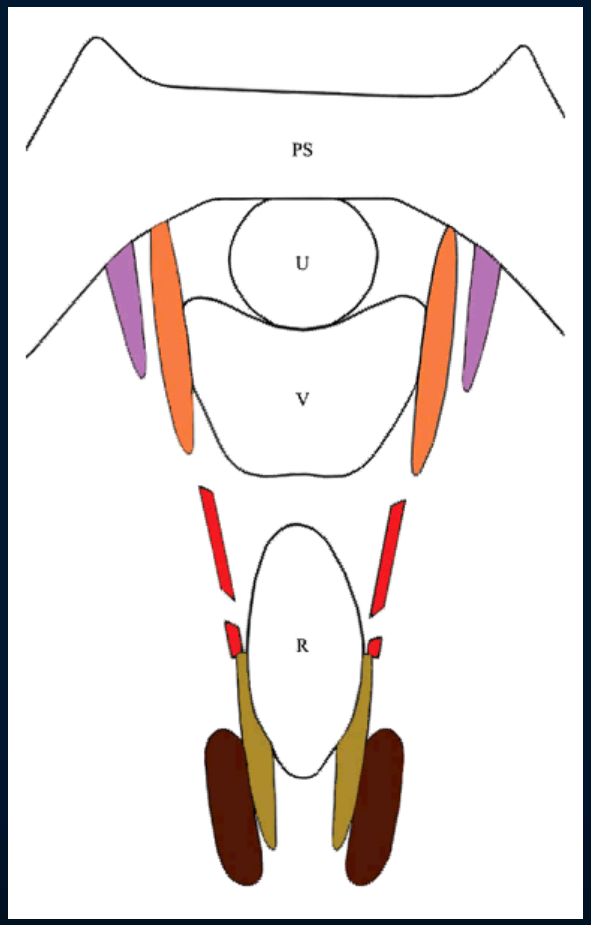

Muscle Length (mm)
300
250
200
150
100
50
0
1
2
5
10
15
20
24
PR
PC
IC
Stretch Ratio
3.5
3
2.5
2
1.5
1
1
2
5
10
15
20
24
Muscle Band

Birth-induced injury

(DeLancey Obstet Gynecol,2003;101:46-53)

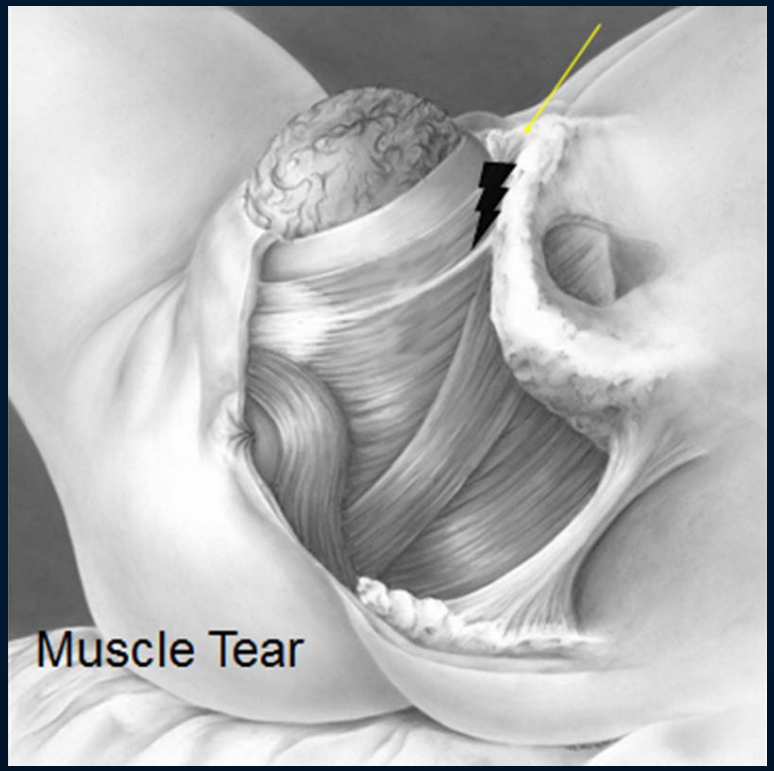


Model Cross-section

Prevention/Recovery

What Caused the LA Defect?

- Muscle tear?
- Nerve injury?
- Compression?



Evaluating Maternal Recovery from Labor & Delivery: Bone and Levator Ani Injuries

Janis Miller, PhD

AJOG 2015;213:188

R21 01-HD049818

P50 HD44406

Study Design

- 68 primiparous women at risk for LA injury
- Investigate women very early post-birth (2-6 wks.)
- Observe the pattern of healing (6-mos) that would point to muscle tear, nerve tear, or nerve/muscle crush injury

Results

- How many were injured?
- What variation in degree?

MRI Findings That Might Point to Injury Mechanism

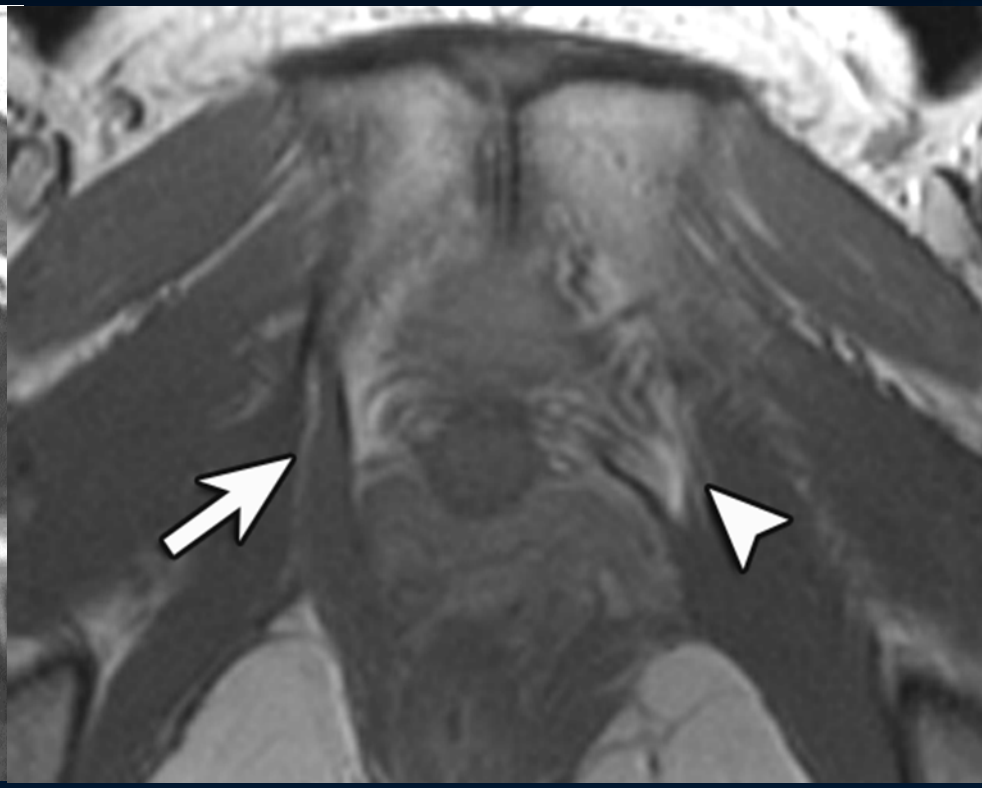
	Early		Late
	Muscle Condition	Edema Pattern	Muscle Bulk
1) Muscle tear	Disrupted	Focal	Lost

MRI Findings That Might Point to Injury Mechanism

	Early		Late
	Muscle Condition	Edema Pattern	Muscle Bulk
1) Muscle tear	Disrupted	Focal	Lost
2) Nerve injury	Non-disrupted	Diffuse	Lost

MRI Findings That Might Point to Injury Mechanism

	EARLY		LATE
	Muscle Condition	Edema Pattern	Muscle Bulk
Muscle tear	Disrupted	Focal	Lost
Nerve injury	Non-disrupted	Diffuse	Lost
Compression	Non-disrupted	Adjacent Muscle Involved	Lost



EARLY

LATE

MRI Findings That Might Point to Injury Mechanism

	EARLY		LATE
	Muscle Condition	Edema Pattern	Muscle Bulk
Muscle tear	Disrupted	Focal	Lost
Nerve injury	Non-disrupted	Diffuse	Lost
Compression	Non-disrupted	Adjacent Muscle Involved	Lost

Correlation of LA injury severity with incontinence symptoms at 7-8 month postpartum

	Correlation Coefficient	p-value
Quantified standing stress test	.08	.52
Sandvik questionnaire	.15	.24
Wei total severity questionnaire	.14	.27
Leakage index questionnaire	.08	.50

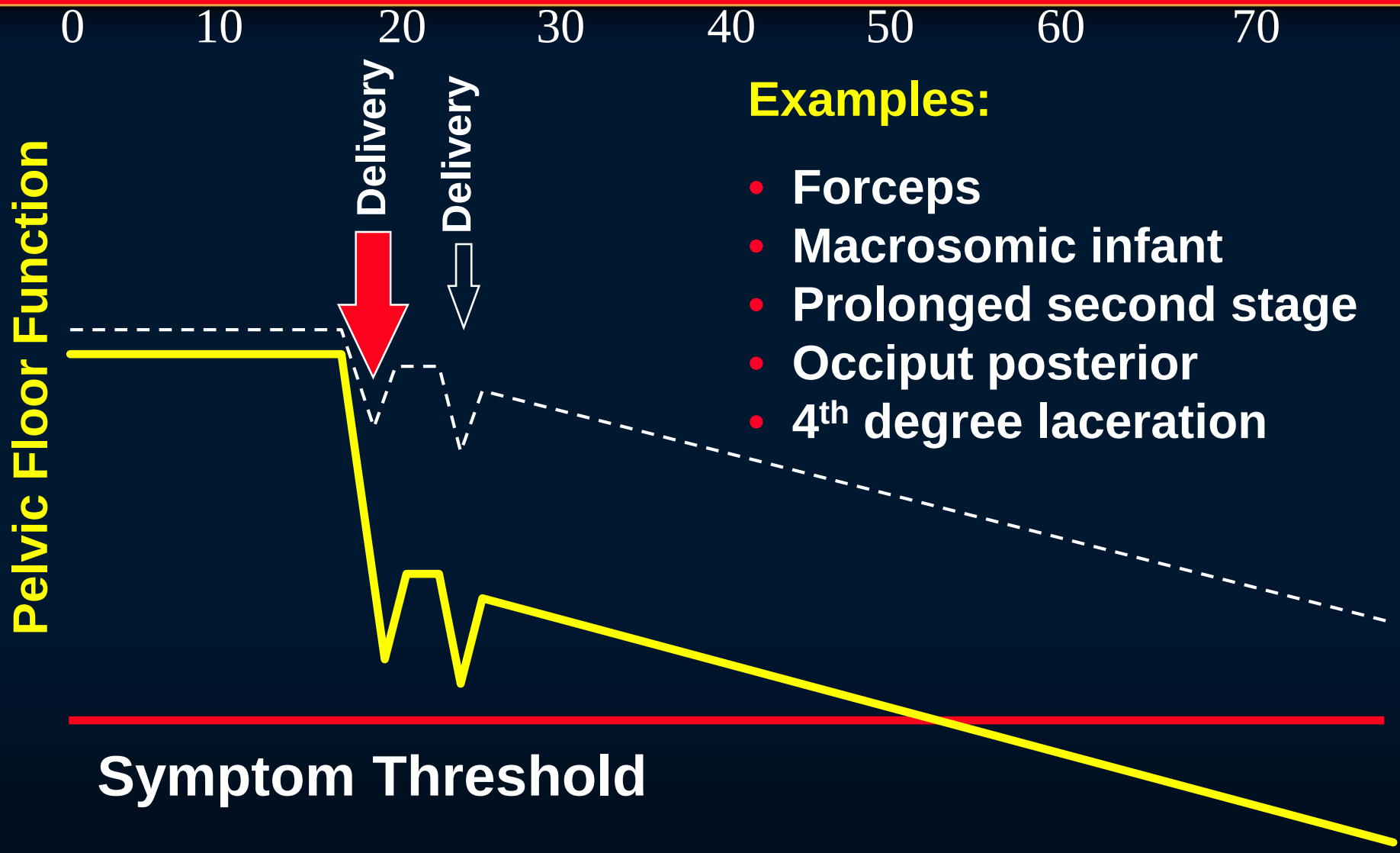
Correlation of LA injury severity 7 -8 months postpartum

	Correlation Coefficient	p-value
MUCP	.06	.69
Wexner fecal incontinence questionnaire	-.13	.30
POP – all components	< .15 for all	ns for all
Pelvic muscle strength on 1-billed speculum	-.43	.001

"Complex Vaginal Births"

- We can predict Levator Ani Injuries
- LA Injuries may not predict immediate symptoms
- SAME risk factors that have been identified for LA injuries also predict symptoms
    - Forceps
    - Older maternal age
    - Sphincter laceration
    - Prolonged second stage
    - Obesity
    - Larger infant

Disease Model



Examples:

- **Forceps**
- **Macrosomic infant**
- **Prolonged second stage**
- **Occiput posterior**
- **4th degree laceration**

Levator ani muscle defects in women with and without prolapse

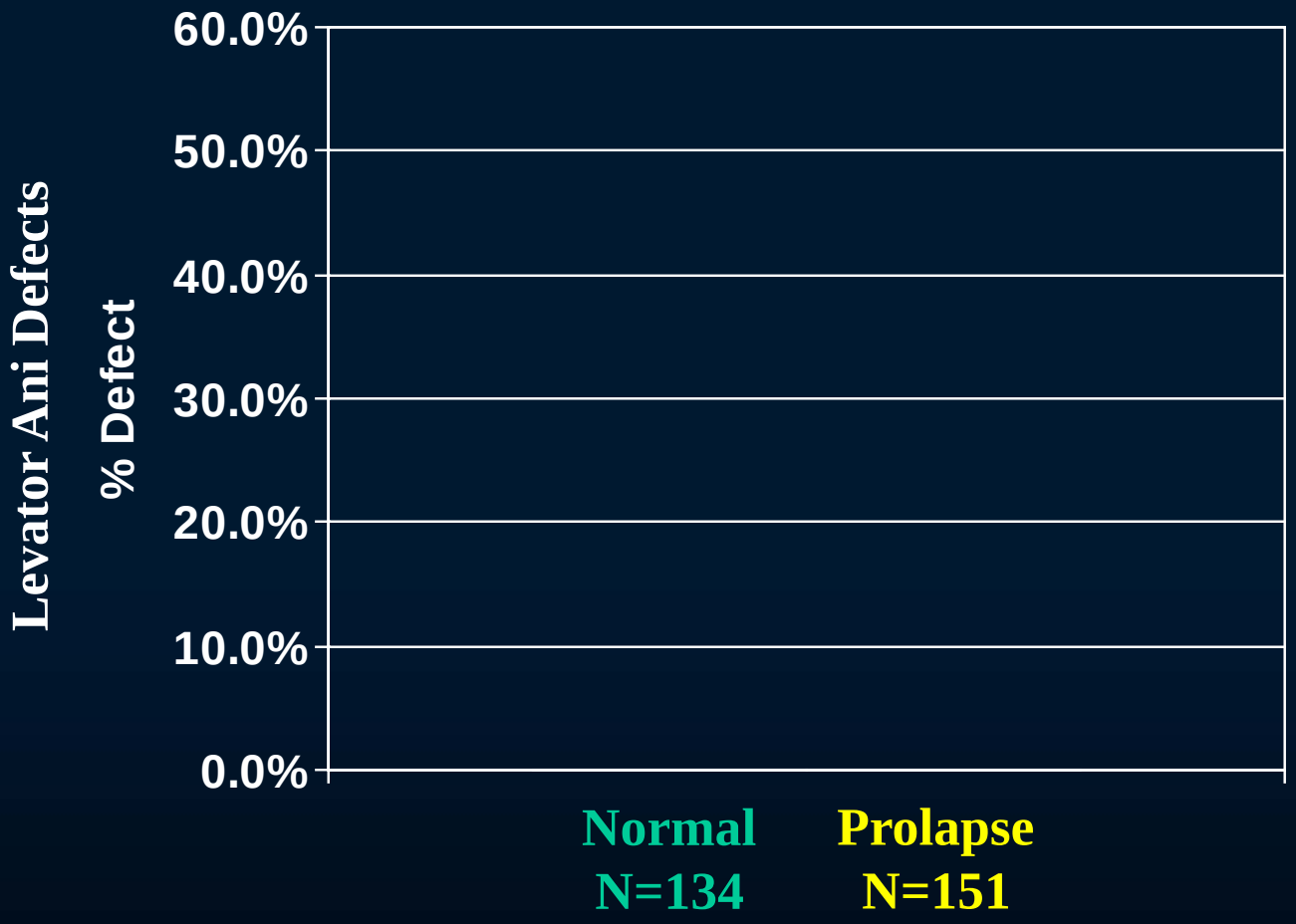
DeLancey, et al. Obstet Gynecol,2007

- Case-Control Study: Group Matching
  - 151 Cases
  - 134 Controls
- Prolapse at least 1 cm below the hymen
- Group matching for age and race
- Full pelvic floor testing (POP-Q, urodynamics, muscle strength, Ultrasound)

Major Levator Ani Defects:

DeLancey, et al. Obstet Gynecol, Feb, 2007

Case-Control Study of Prolapse

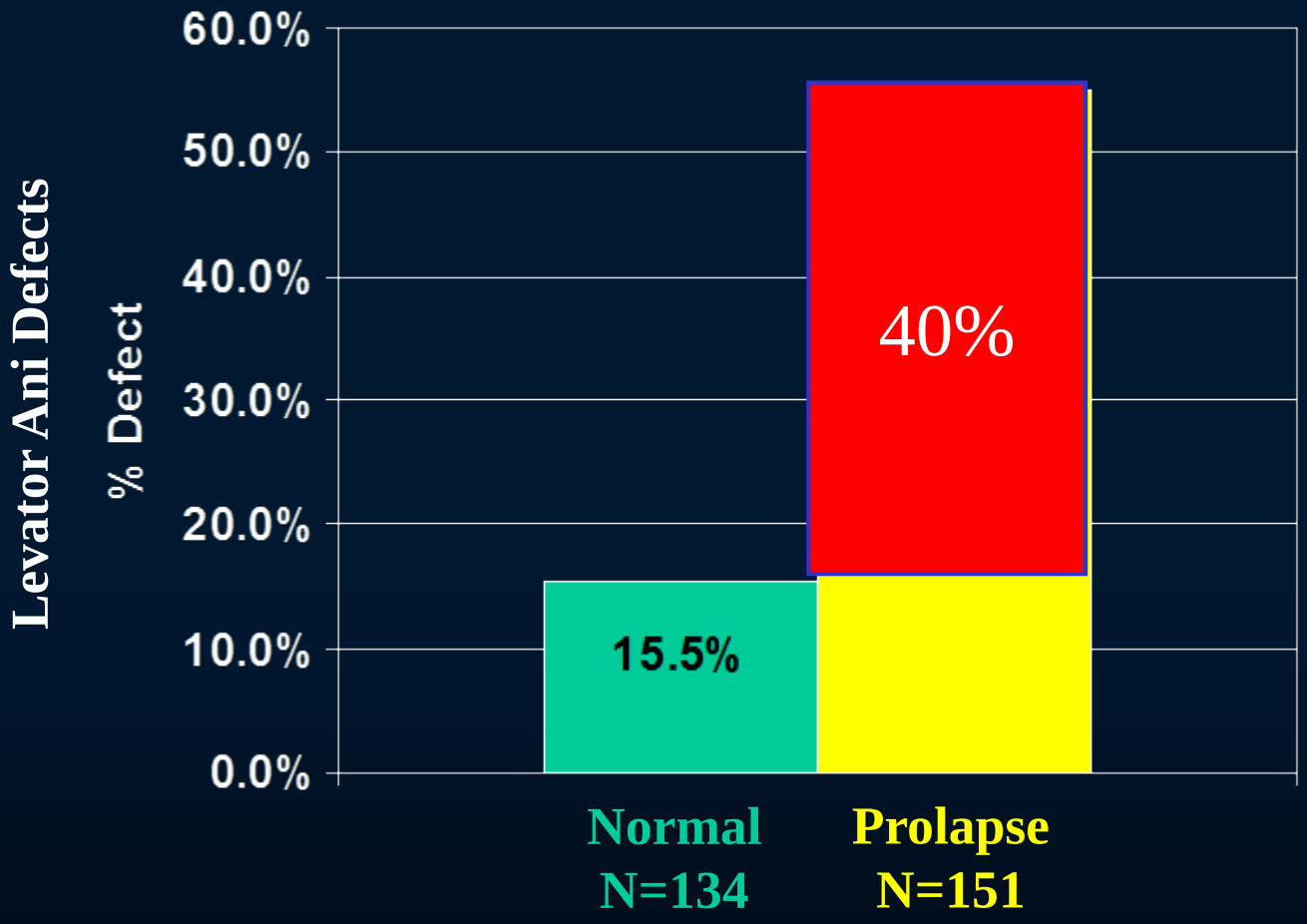


DeLancey

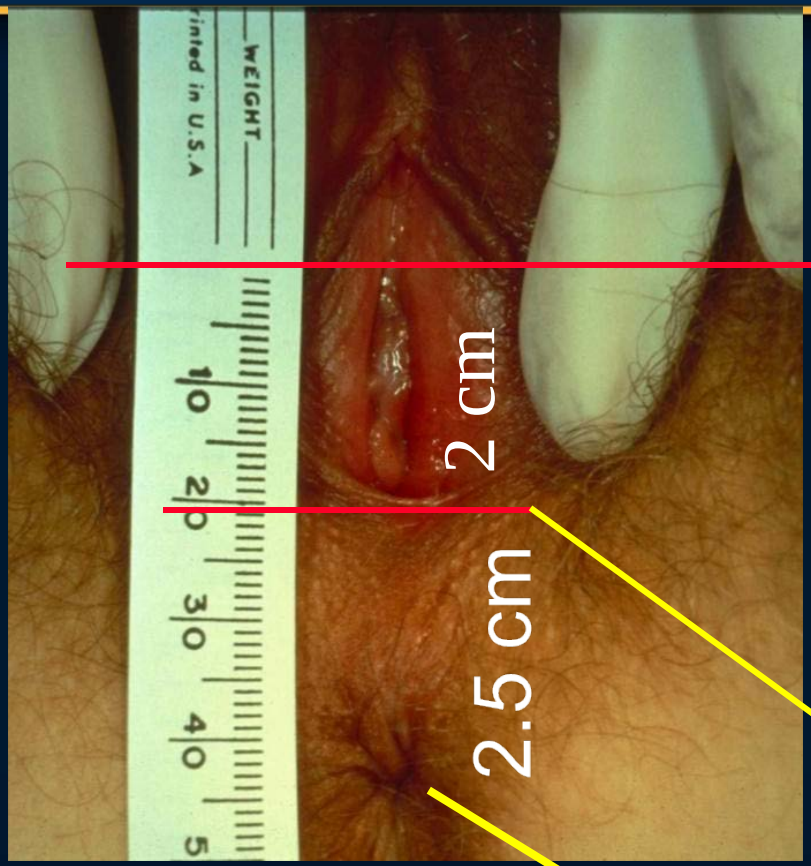
Major Levator Ani Defects:

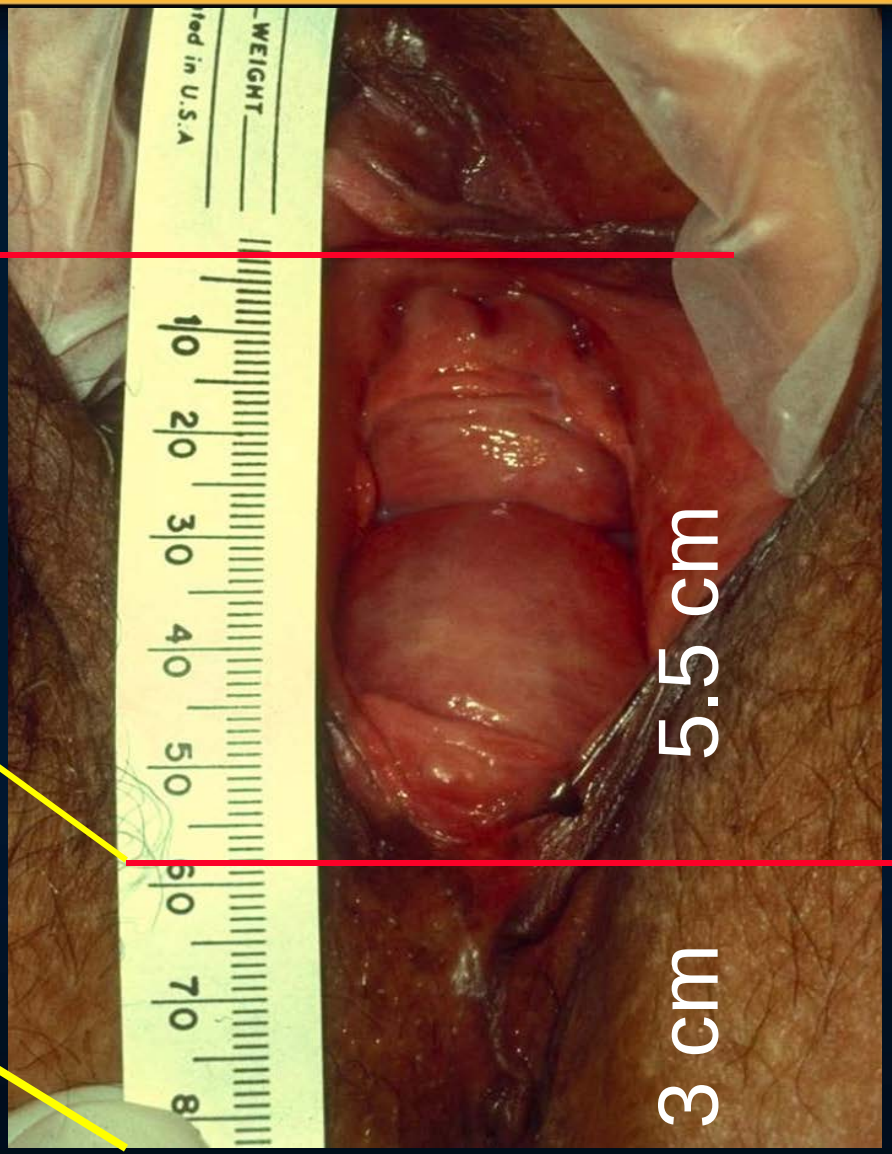
DeLancey, et al. Obstet Gynecol, Feb, 2007

Case-Control Study of Prolapse

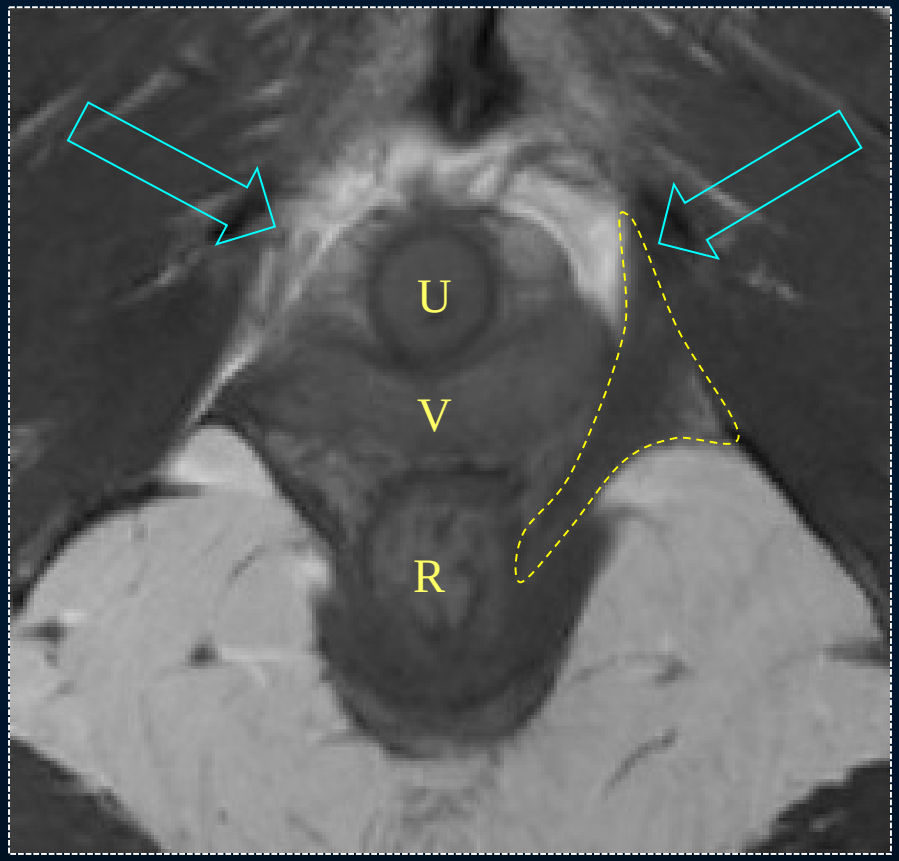


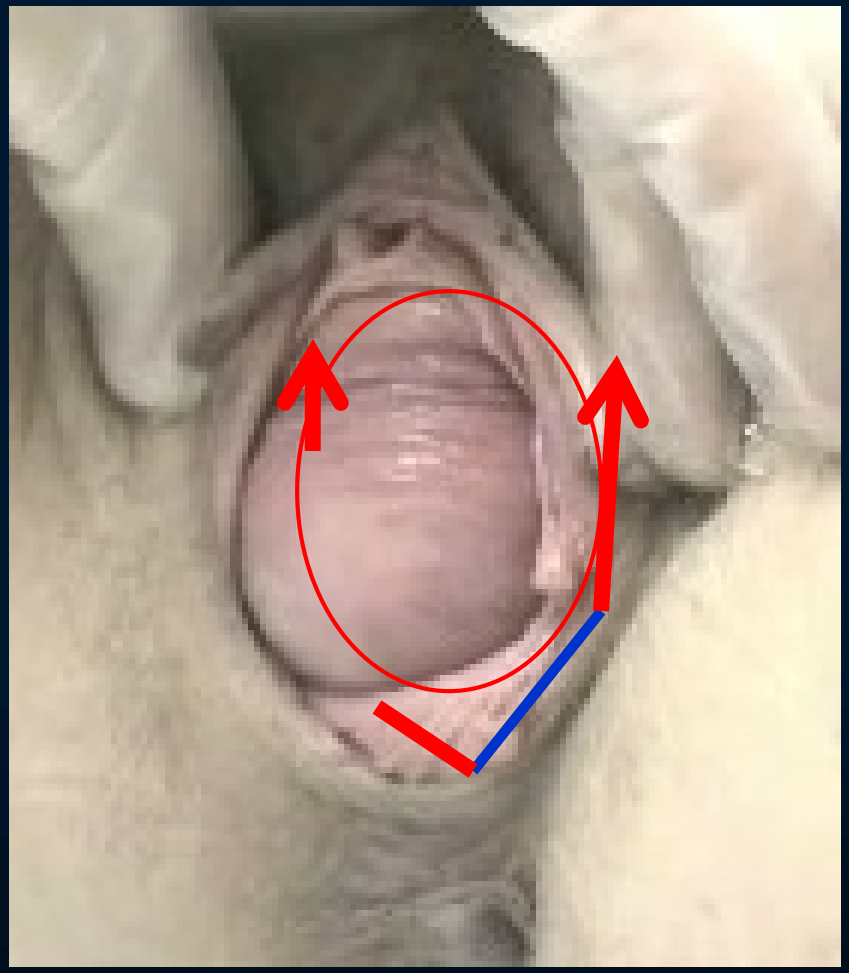
What does a levator injury look like?





Imaging





Clinical Take Home

- Shortening the second stage for prolonged compression not necessary
- Slow gradual delivery(as we do) is optimal
- Recognize forceps delivery risk
- Strategies to reduce injury; tissue “softening”: (e.g. pre-stretching perineum) now under development
- “VagiDil” in the future
- C/Section; Would it be right to section 9 women (twice) to prevent a treatable problem later?
- Look for strategies to promote recovery

Disease Prevention

- Stop Exposure (Cesarean Section)
- Alter/Minimize Exposure (No forceps)
- Determine who is at greatest risk
- Who does not recover?

Recovery for Low Risk Women

- Young
- No major medical problems
- No major obstetric complications
- Mostly Uncomplicated Deliveries
  - Low rates of instrumented Delivery
  - Low rates of sphincter injury

DOI: 10.1111/1471-0528.12571
www.bjog.org

Contribution of the second stage of labour to pelvic floor dysfunction: a prospective cohort comparison of nulliparous women

RG Rogers,[a] LM Leeman,[b] N Borders,[c] C Qualls,[d] AM Fullilove,[c] D Teaf,[e] RJ Hall,[c] E Bedrick,[f] LL Albers[g]

- APPLE study
- Childbirth and the pelvic floor
- Midwifery Patients
- 6 month follow up

Patient Population

- 336 vaginal births
  - Mean age 23.9 ± 4.9
  - Operative Delivery 5%
  - Episiotomy 2%
  - Anal Sphincter Lac 5%
- 138 Cesarean prior to Second Stage
  - Mean age 26.6 ± 6.1

Rates of Anal Incontinence

	Vaginal Del	C-Section	
Any anal incontinence (Wexner* ≥ 1) (%)	163 (50)	76 (55)	0.26
Fecal incontinence, positive response on Wexner scale (%)	27 (8)	18 (13)	0.12

Rates of Urinary Incontinence

Urinary incontinence	Vaginal birth *n* = 336	Caesarean delivery *n* = 138	*P*
Any urinary incontinence, ISI > 0 (%)	183 (55)%	63 (46)%	0.08
Moderate/ severe ISI scores (%)	30 (9)%	8 (6)%	0.35
Paper Towel Test wet (%)	56 (17)%	8 (6)%	0.002

Rates of Prolapse

Pelvic organ prolapse	Vaginal birth *n* = 336	Caesarean section *n* = 138	
POPQ Stage prolapse			
0	46 (14)	28 (22)	0.03**
1	209 (65)	81 (63)	
2	66 (21)	19 (15)	
Ba (mean ± SD)	−1.9 ± 0.8	−2.1 ± 0 .7	<0.001

Incontinence QOL Measures

- Anal Incontinence
  - No difference
- Urinary Incontinence
  - No difference
  - Urge > Stress for C/S Group

QOL for Women with Stage 2+ Prolapse

	Vaginal	Cesarean	
Women with stage 2 or greater prolapse	***n* = 67** 21%	***n* = 19** 15%	
Pelvic organ prolapse impact Scores among women with stage 2 or greater POP (mean ± SD)	3.5 ± 11.8	1.3 ± 4.5	0.21

APPLE Take Home

- Most low risk women recover well
- Low rates of Urinary Incontinence, Fecal Incontinence, and Prolapse
- Minimal symptoms
- Cesarean Section is not protective for postpartum symptoms

Recovery for High Risk Women

- Older than 32
- Longer second stages of labor
- Instrumented Delivery
  - Forceps
  - Vacuum
- Anal sphincter injury
- Episiotomy
- Symptoms did not predict LA injuries
- Injuries associated with posterior wall descent and decreased pelvic muscle strength

Prevention/Recovery

- Epidemiology
- Disease Model
- Risk vs. Benefit of Intervention
- Natural history of healing for high risk women

PFRG Pelvic Floor Research Group

The POPI Study

Predicting Optimal Postpartum Recovery from Injury

FUNDED BY PRIVATE DONOR

Aims

- Determine what “normal” recovery looks like for High Risk Women
- Compare pelvic floor recovery in high risk women to cesarean delivery controls
  - Function
  - Symptoms
- Examine the utility of early postpartum screening for injury
  - Clinical markers of injury

Inclusion Criteria

- Vaginal Birth Cohort
  - Primiparous
  - High-risk based on known risk factor

- Cesarean Cohort
  - 1st or 2nd cesarean delivery
  - No second stage

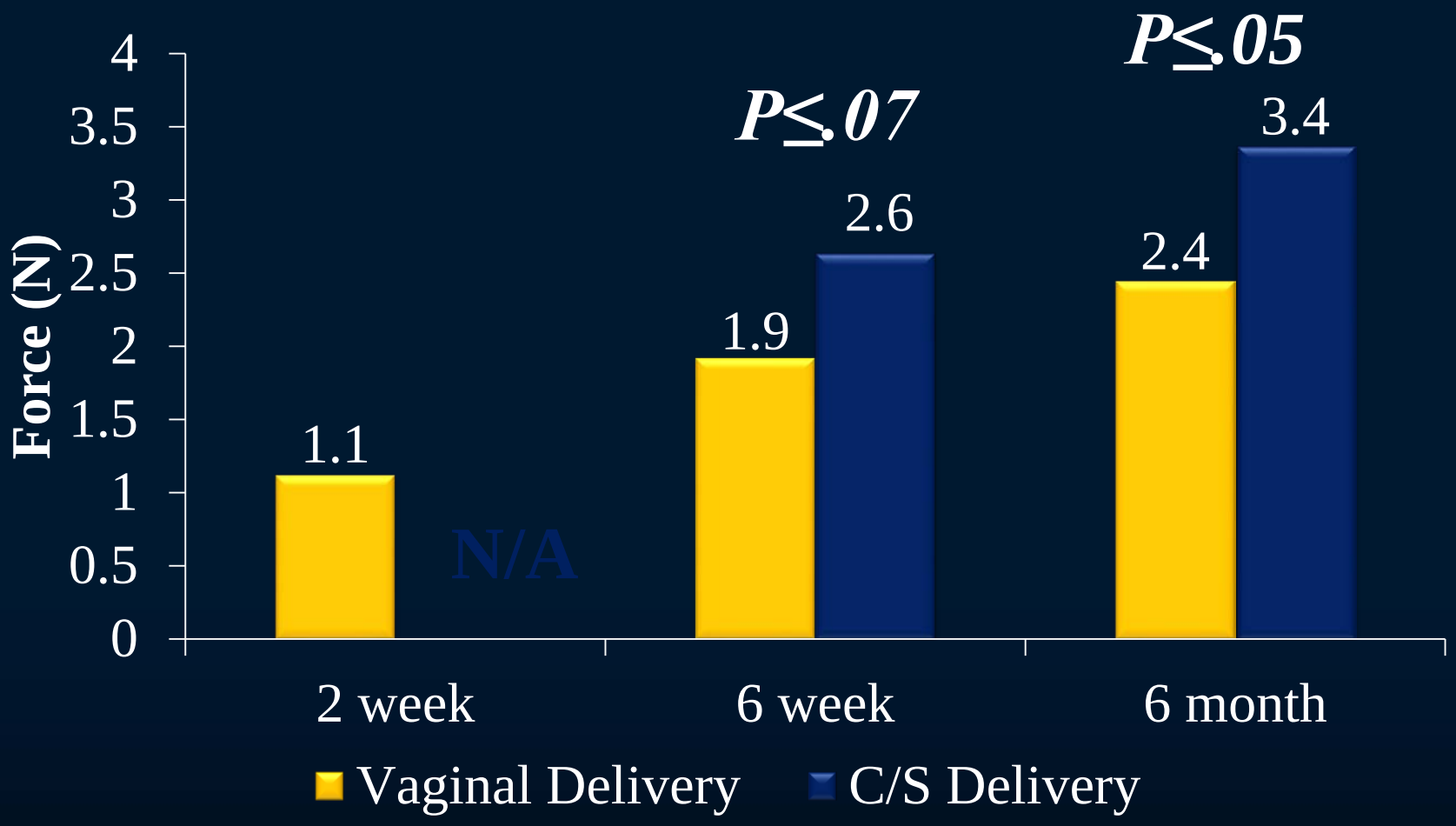
The Trajectory of Recovery in Women at High Risk for Birth Injury

- Analysis
  - Descriptive
    - What does recovery look like?
  - Comparative
    - How does recovery differ between High Risk women and cesarean controls

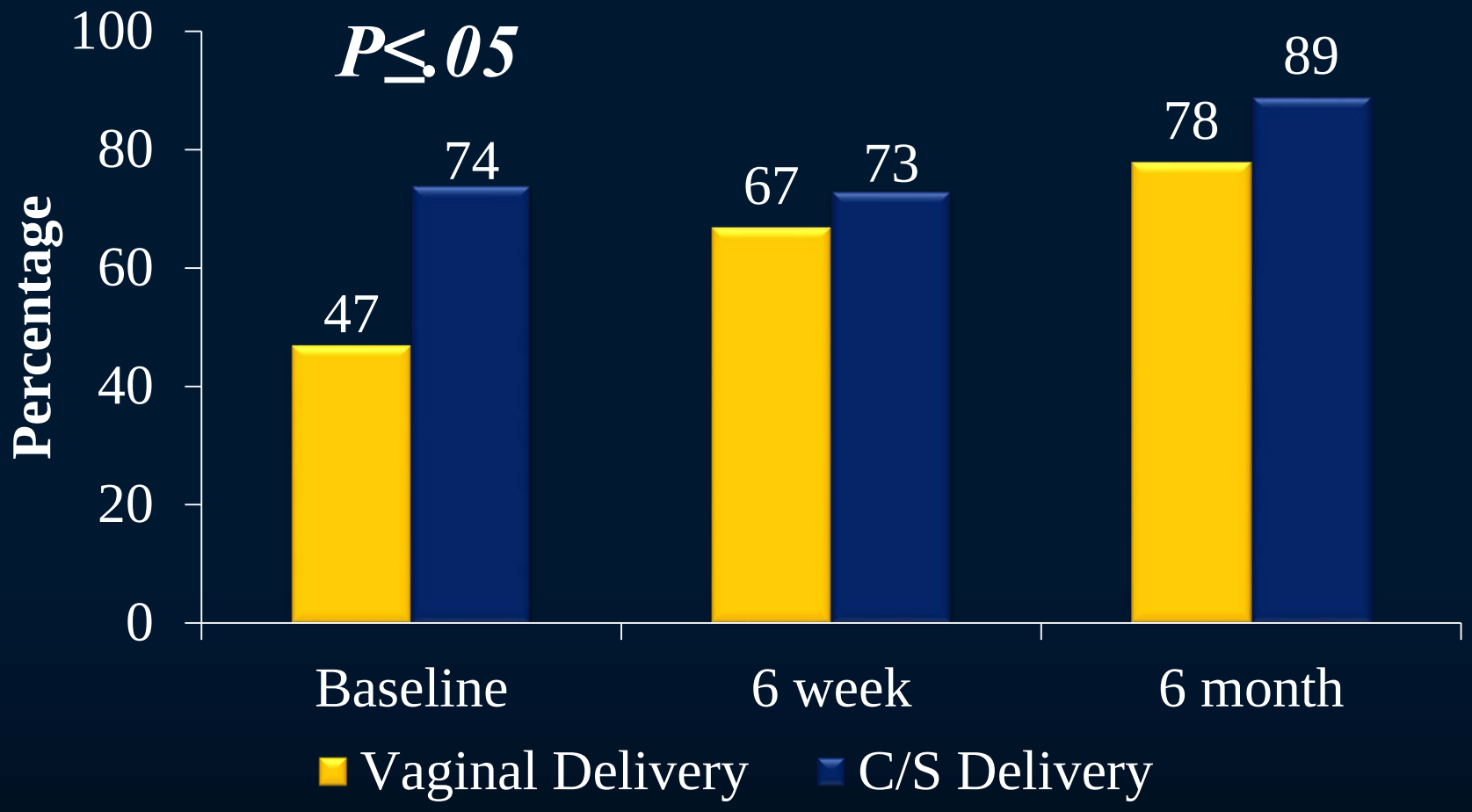
Preliminary Results

- 96 women
  - 76% High-risk Vaginal Births
  - 24% Cesarean Controls
- Number of women at each time point variable due to ongoing data collection
- Demographics similar except
  - Cesarean group slightly older with lower gestational age at delivery

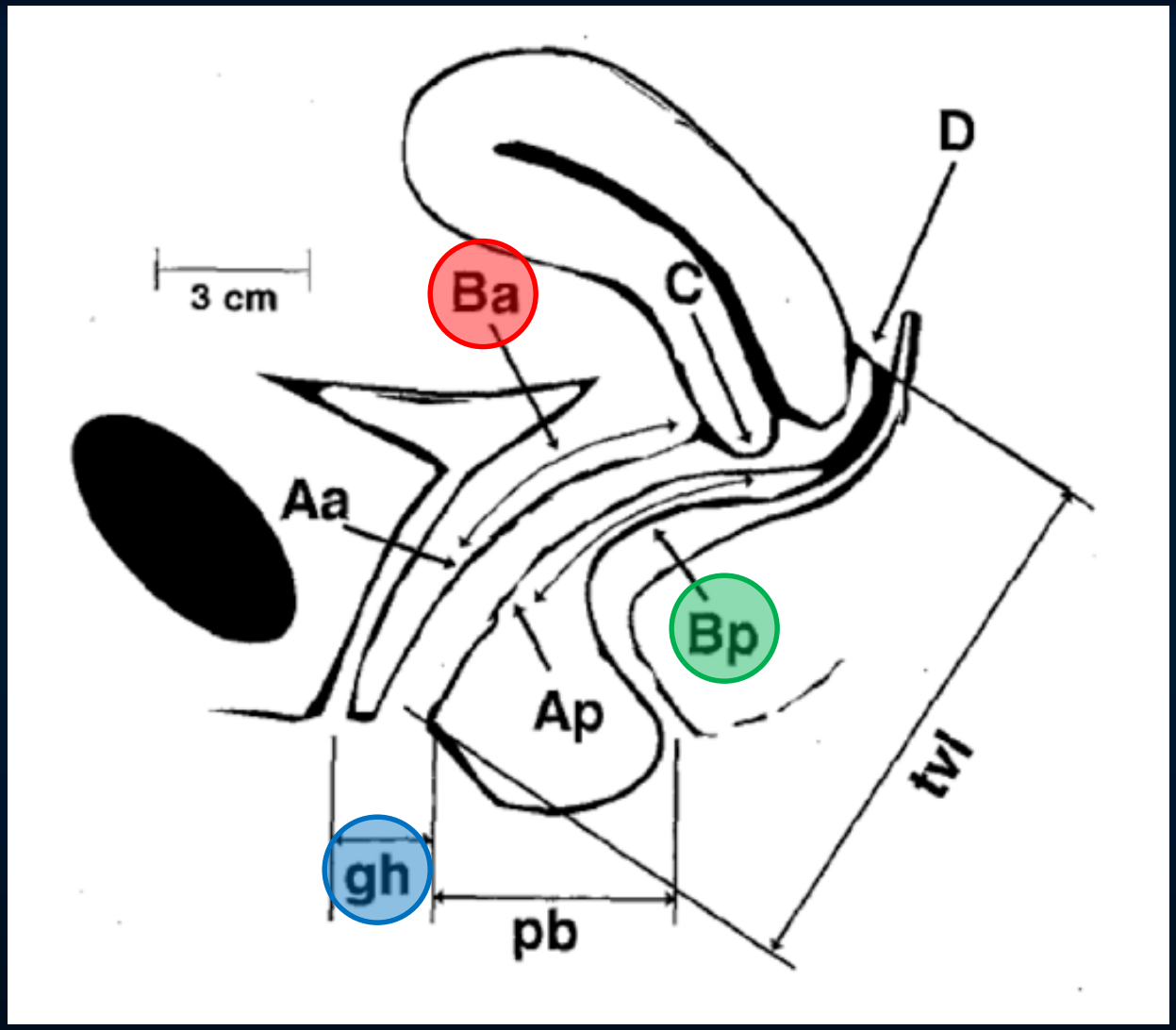
Levator Strength



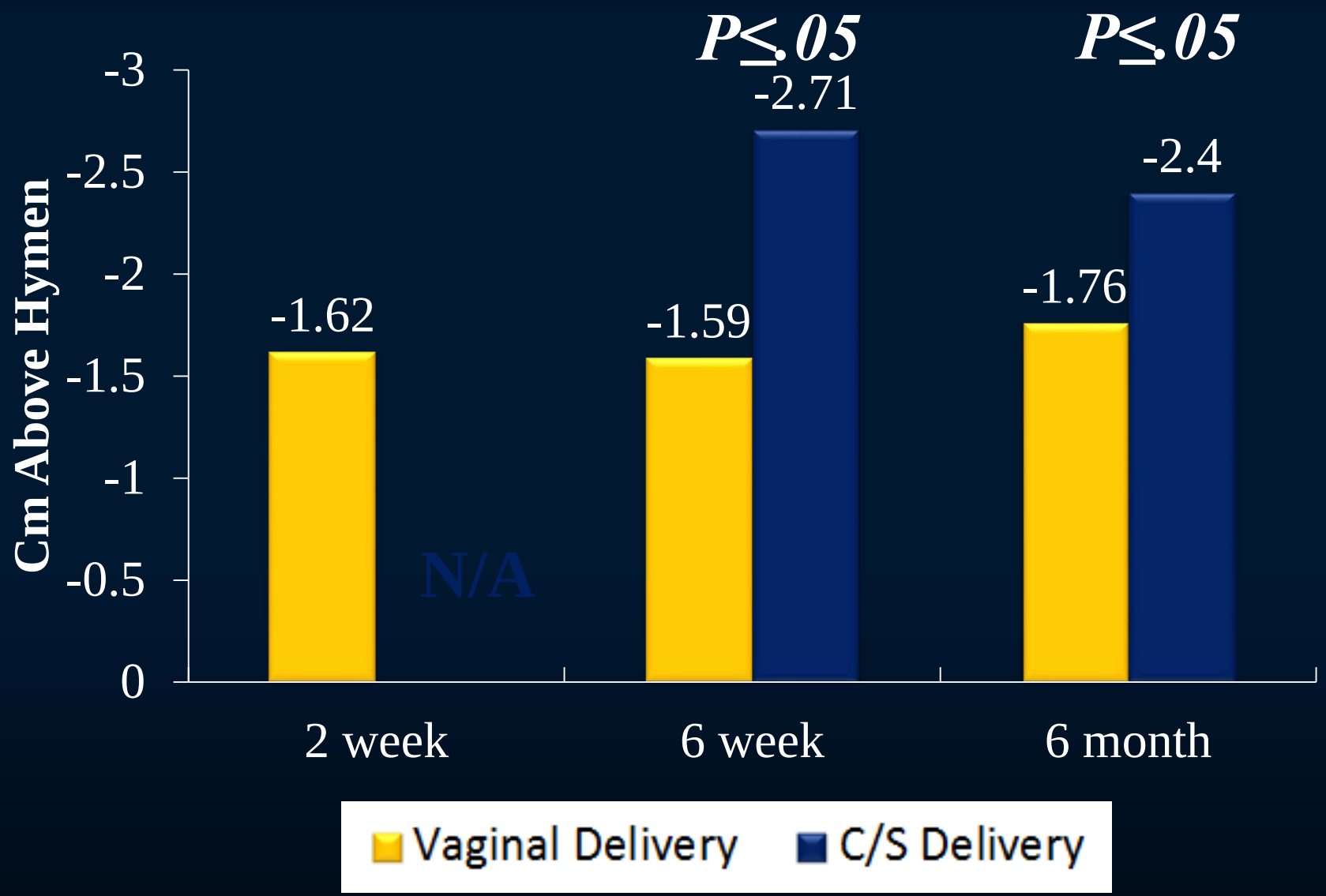
Ultrasound Visualization of Bladder Lift



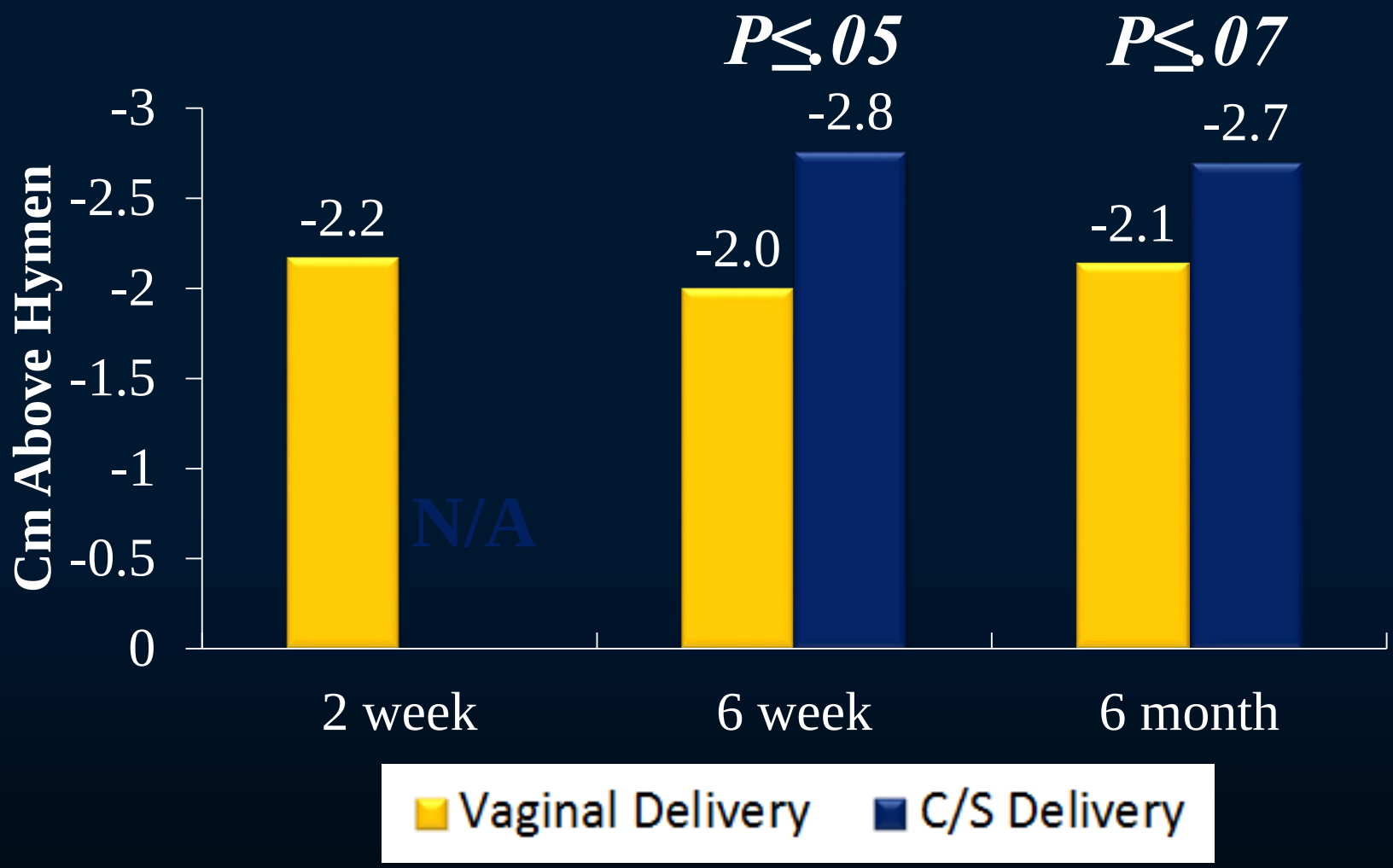
Measures of Pelvic Floor Appearance



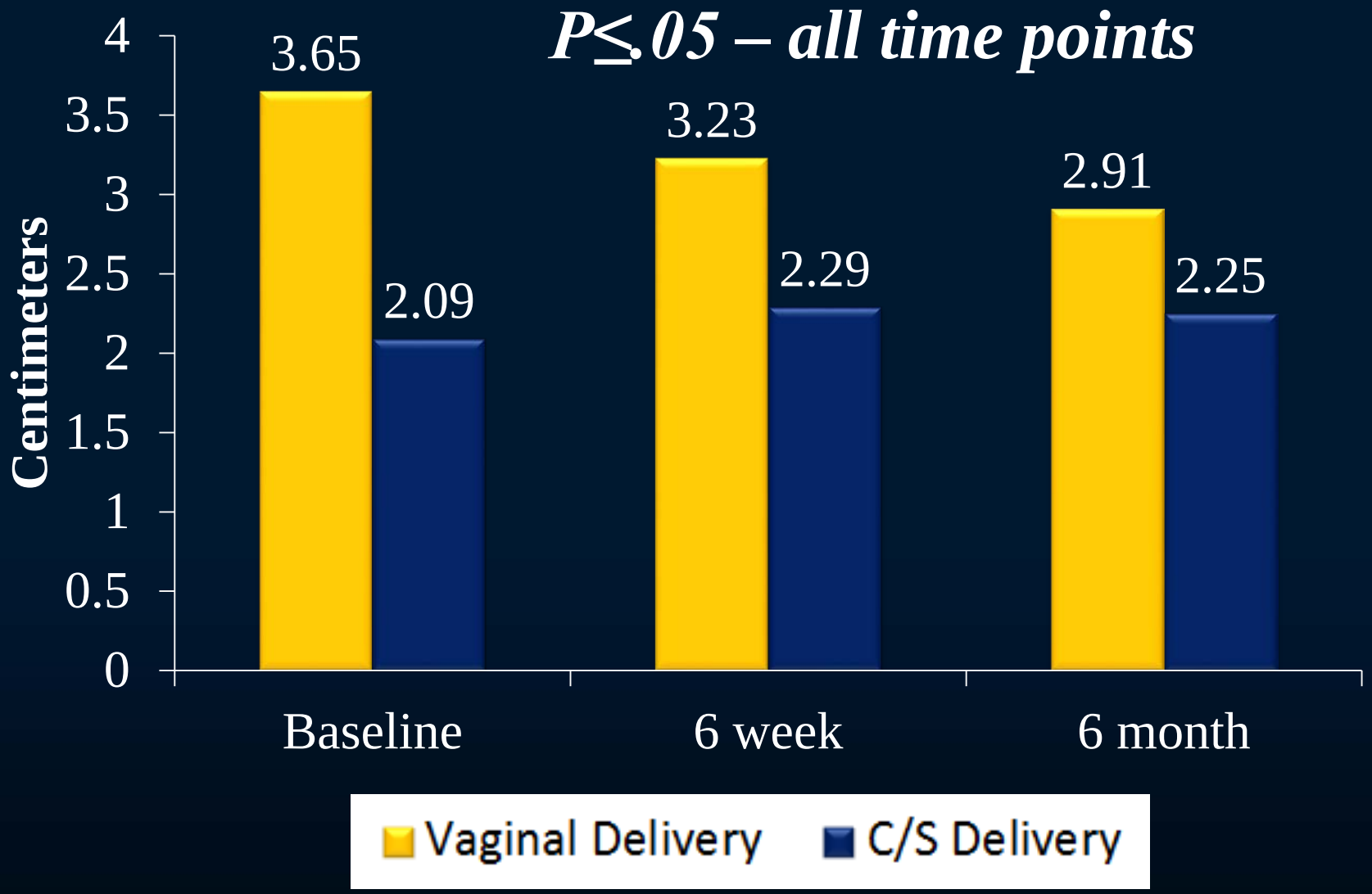
Anterior Wall Position (Ba)



Posterior Wall Position (Bp)



Length of GH

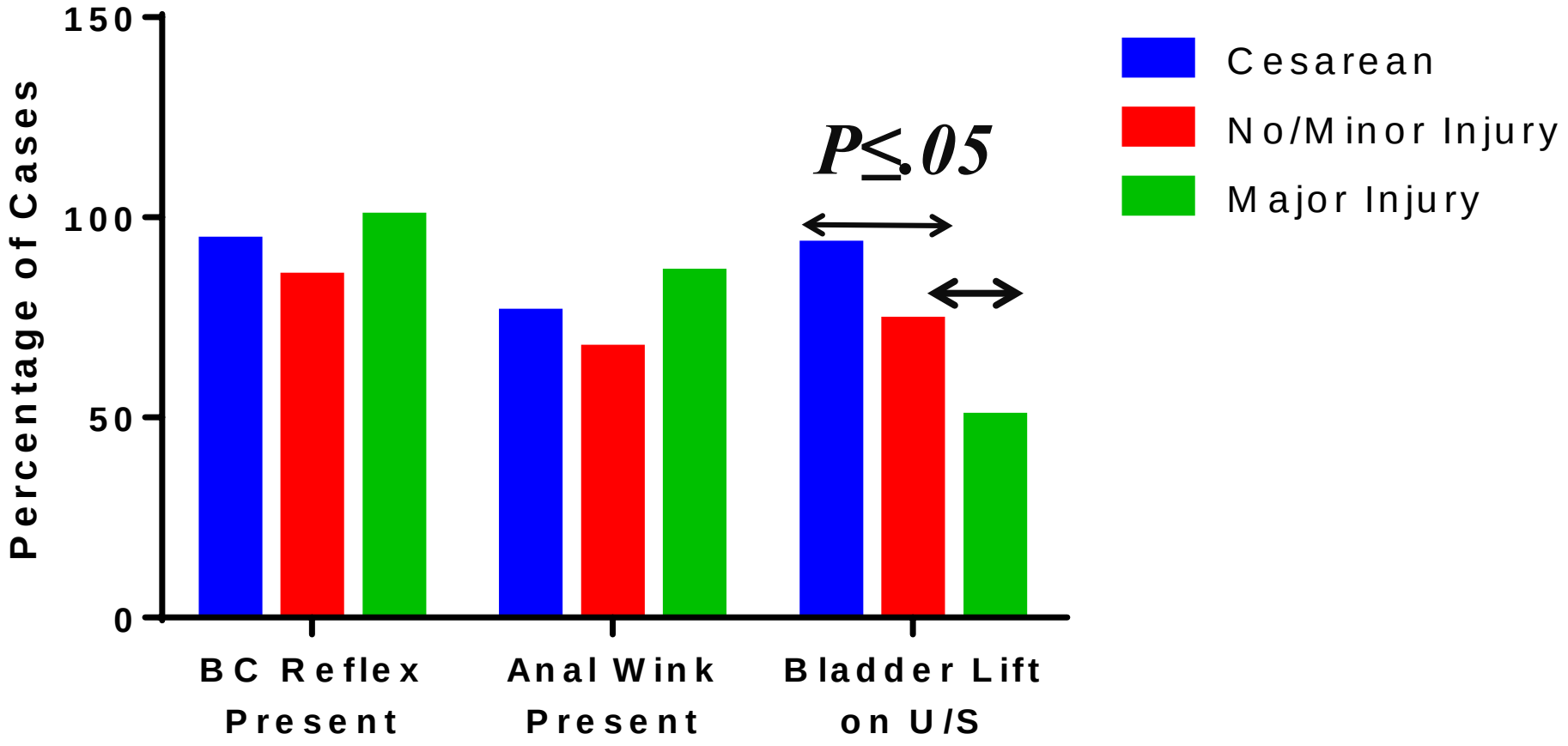

P≤.05 – all time points
Centimeters
4
3.5
3
2.5
2
1.5
1
0.5
0
3.65
2.09
3.23
2.29
2.91
2.25
Baseline
6 week
6 month
Vaginal Delivery
C/S Delivery

Levator Injury

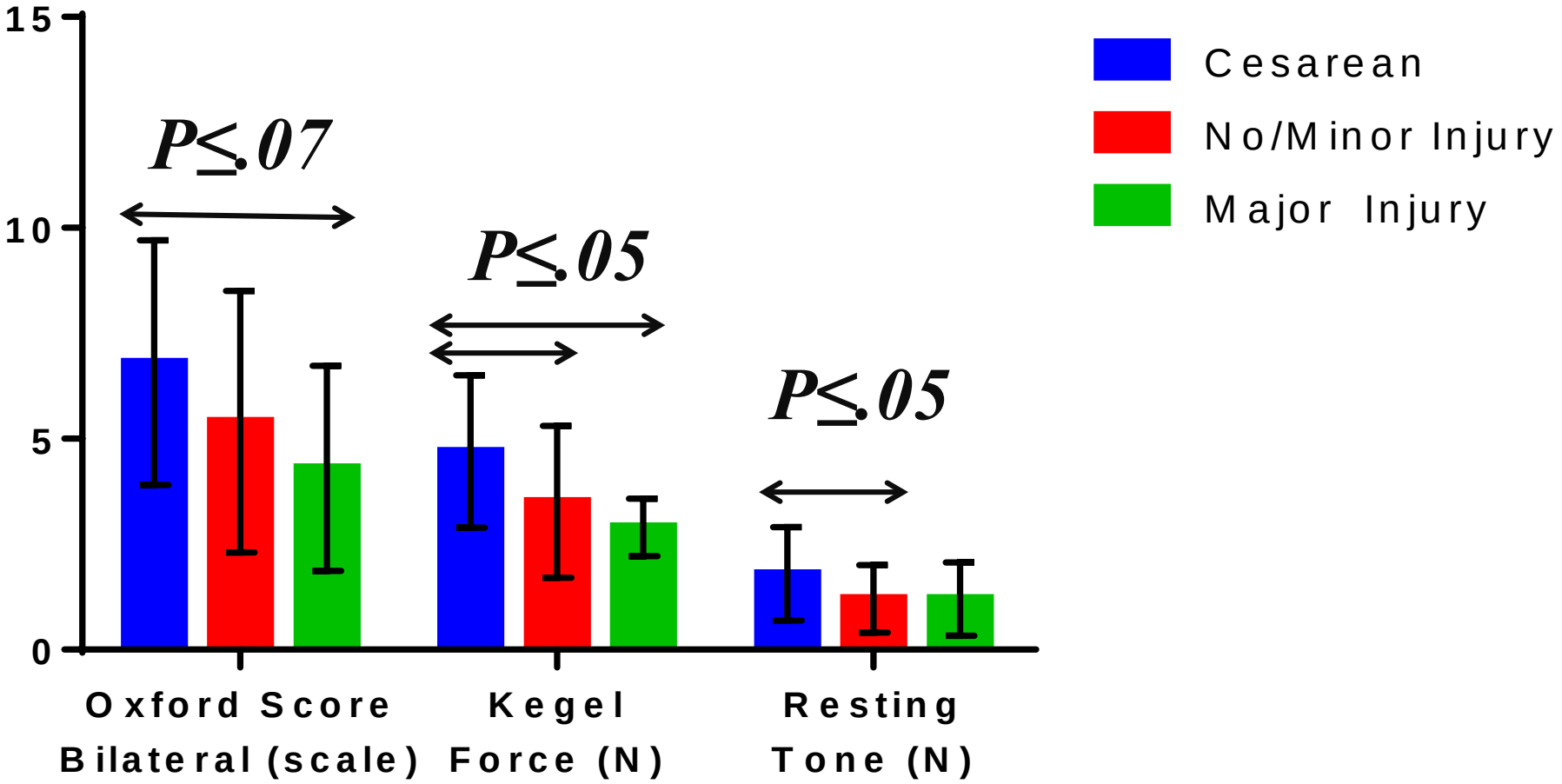
Injury Rate

- High-risk Vaginal Birth injury rate 33%
  - Major Levator injuries 8 (19%)
  - Minor Levator Injuries 6 (14%)
  - No Injuries 28 (67%)
- Cesarean Birth
  - No injuries

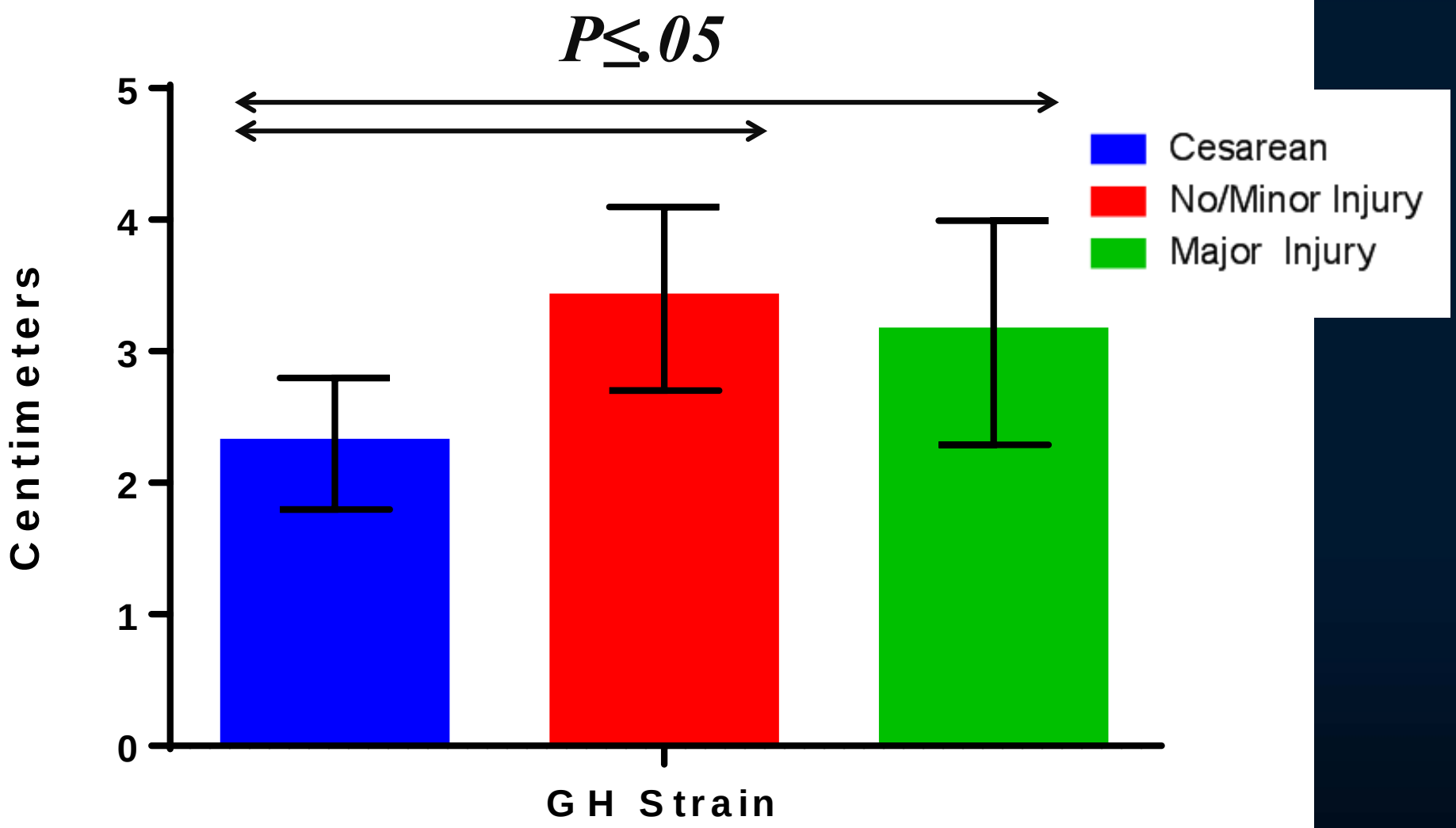
Measures of Function



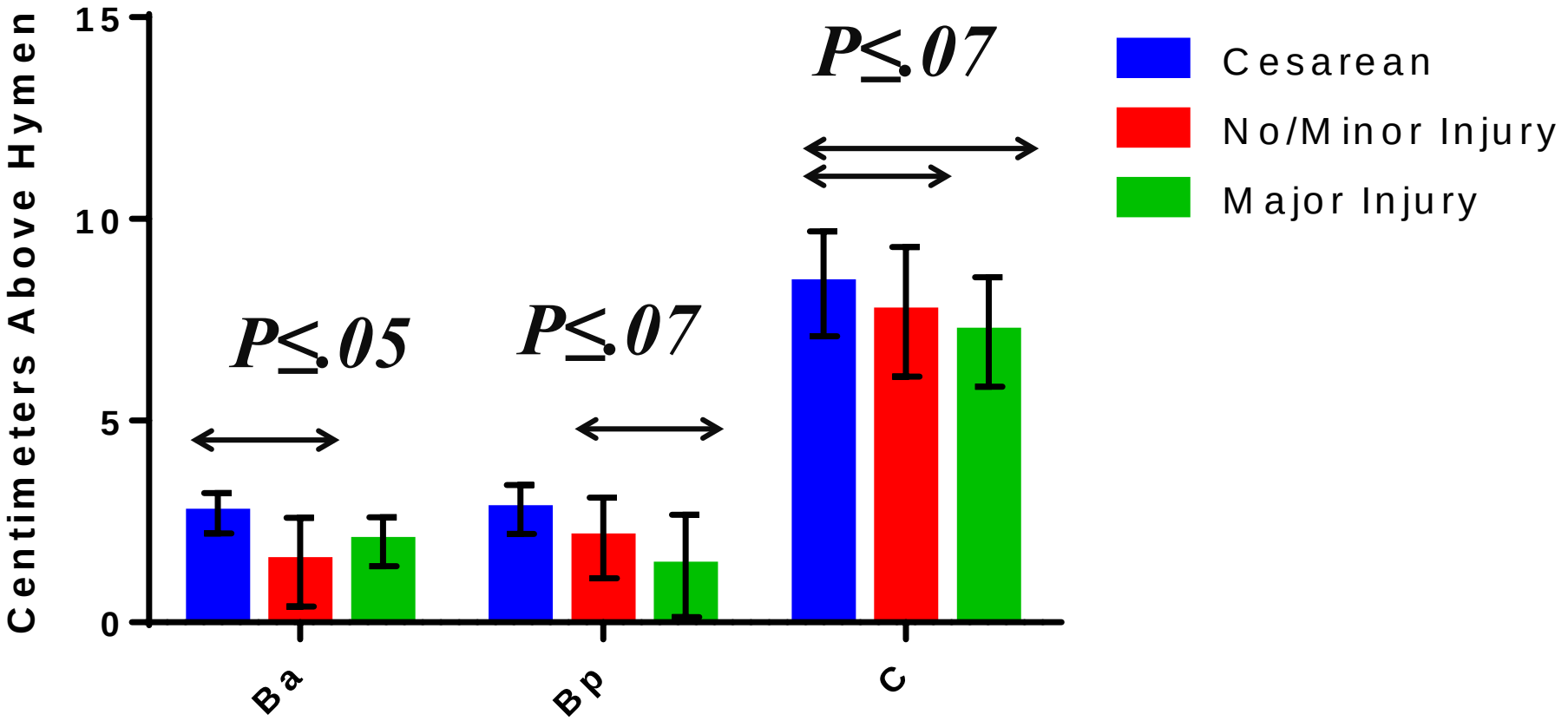
Measures of Strength



Length of Genital Hiatus with Strain



POPQ Measures



Summary of Findings

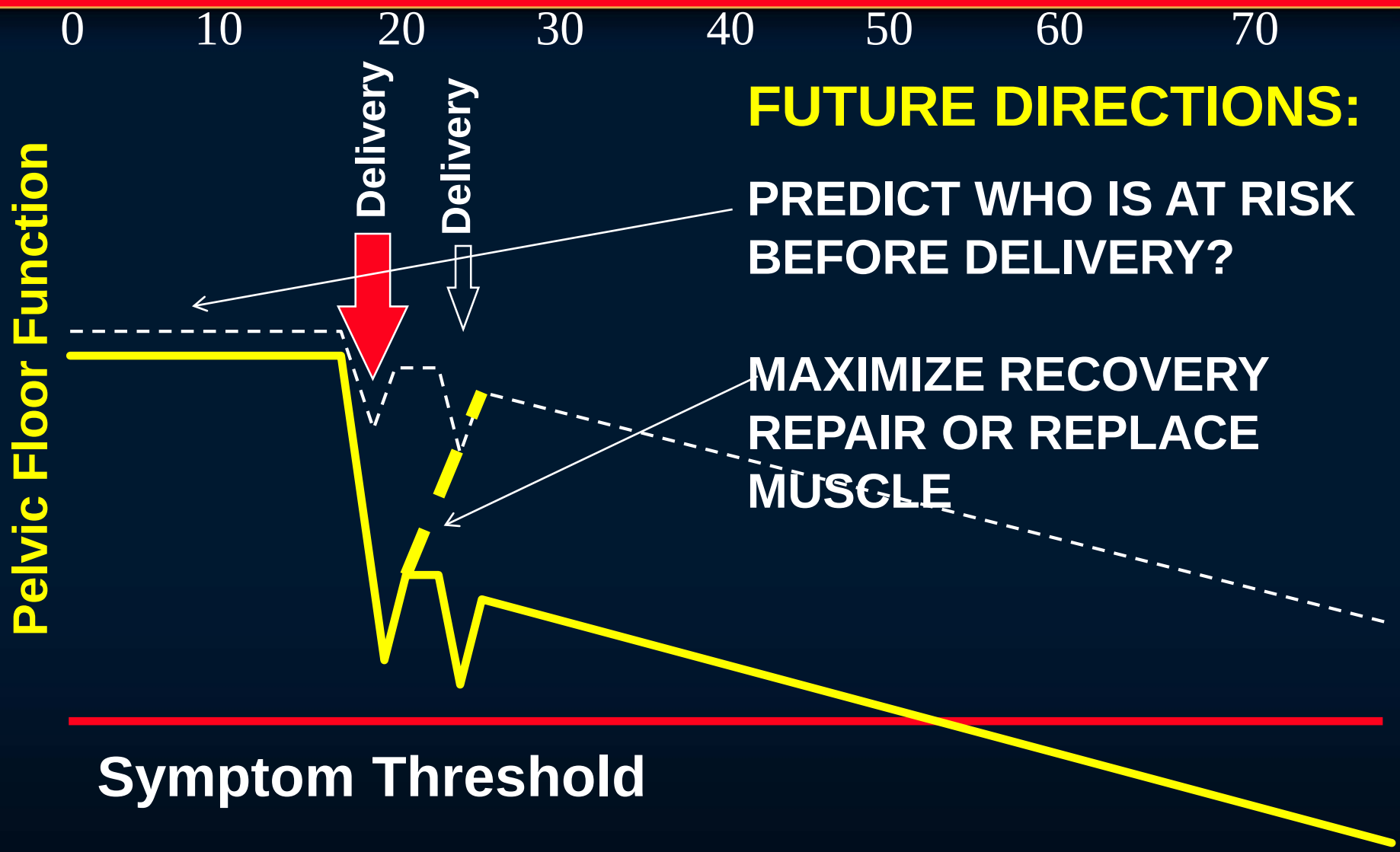
High-risk Births vs Cesarean Controls

- High risk vaginal births
  - Decreased strength at 6 weeks
  - Larger Genital Hiatus at 6 weeks and 6 months
  - Lower Anterior and Posterior Walls at 6 weeks and 6 months

Signs of Levator Injury

- Lower posterior walls and wider hiatus in women with major injuries
- Trend towards decreased measures of pelvic muscle strength in women with major injuries
- Potential markers of underlying injury

Disease Model



FUTURE DIRECTIONS:

PREDICT WHO IS AT RISK BEFORE DELIVERY?

MAXIMIZE RECOVERY REPAIR OR REPLACE MUSCLE

A[illegible]iliar Scenario

Auxiliar Scenario

VAGINAL BIRTH AFTER CESAREAN Height & weight optional; enter them to automatically calculate BMI	
Maternal age	18 ▼ years
Height (range 54-80 in.)	in
Weight (range 80-310 lb.)	lb
Body mass index (BMI, range 15-75)	25 ▼ kg/m^2
African-American?	no ▼
Hispanic?	no ▼
Any previous vaginal delivery?	no ▼
Any vaginal delivery since last cesarean?	no ▼
Indication for prior cesarean of arrest of dilation or descent?	no ▼
Calculate	

VAGINAL BIRTH AFTER CESAREAN

Predicted chance of vaginal birth after cesarean: **71.8%**

95% confidence interval: [**69.4%**, **74.1%**]

Recalculate

POP-GAR

	6 WEEKS POST-PARTUM	
AGE		
BMI		
2ND STAGE		
FORCEPS		
KEGEL		
GH		
BLADDER LIFT		

	RISK
LEVATOR INJURY	79%