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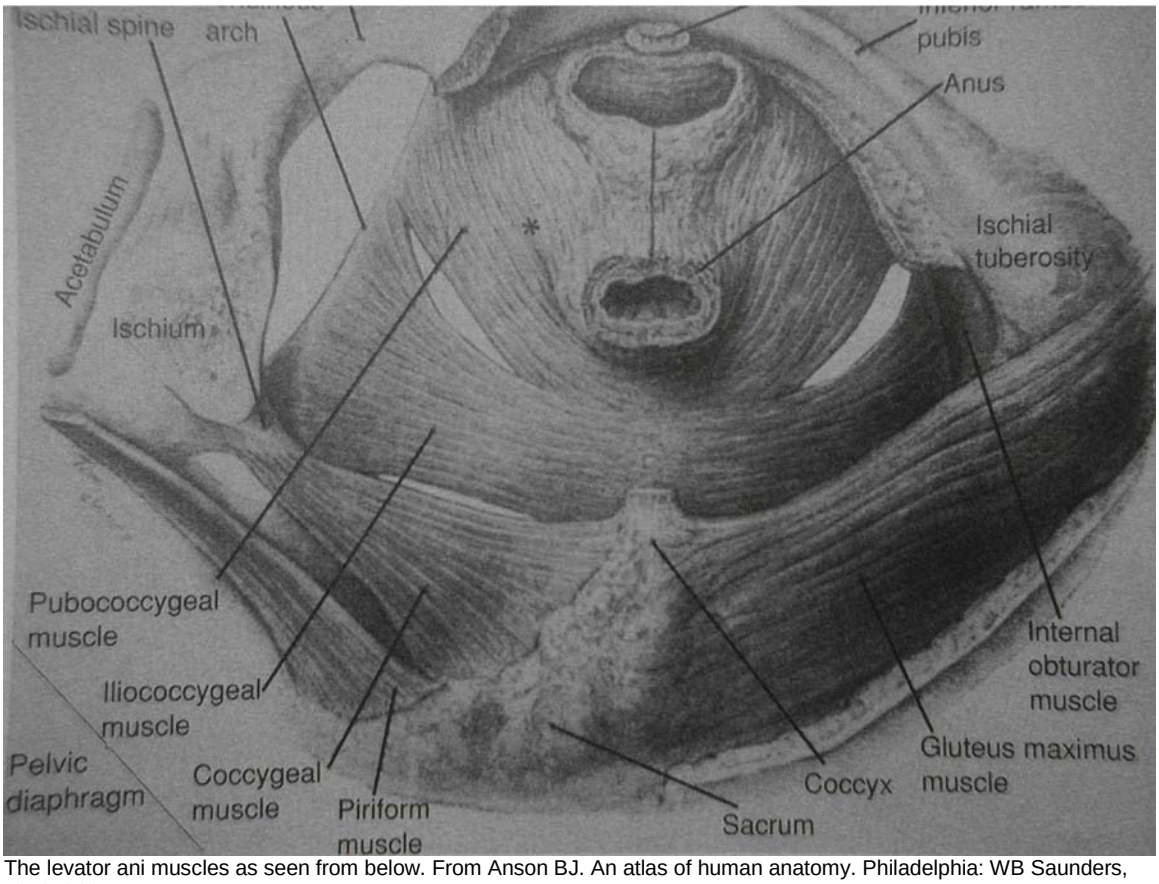
18 April 2003

Urinary Incontinence after Vaginal and Cesarean Delivery

The Pelvic floor consists of:

1. urethral and anal sphincter muscles
2. endopelvic fascia
3. levator ani muscles: the largest component; two major parts
   a. paired iliococcygeus muscles
   b. pubovisceral muscle, which includes the puborectalis and the pubococcygeus



The levator ani muscles as seen from below. From Anson BJ. An atlas of human anatomy. Philadelphia: WB Saunders, 1950: 366.

Two important functions of the levator ani[1]

1. Maintains a constant basal tone and keeps the urogenital hiatus closed. If tone is lost or diminished, the hiatus can widen, facilitating descent of the pelvic viscera.
2. contract reflexively in response to certain actions that increase intrabdominal pressure (e.g. coughing)

The levator ani and the sphincter muscles are innervated by anterior sacral nerve roots S2-S4, Direct motor branches from these roots travel over the cranial surface of the pelvic floor, where they are vulnerable to stretching and compression during parturition.

Mechanisms if Injury

1. direct compression during childbirth from the fetal presenting part
2. downward pressure from maternal expulsive efforts
3. mediolateral and midline episiotomy
4. lacerations
5. damage to peripheral nerves that innervate the levator ani and sphincter muscles
    a. Neurophysiologic techniques (concentric needle EMG and single fiber EMG) have demonstrated denervation injuries to the pubococcygeus and the external anal sphincter muscles in 42-80% of a series of vaginal deliveries. Denervation was not seen after elective cesarean section, although it has been associated with cesarean deliveries performed during labor.

Postpartum Physiology relating to urinary incontinence[2]

1. urethral mobility is increased after vaginal delivery
2. loss of urethral support after vaginal delivery may be associated with the subsequent development of urinary incontinence
3. Vaginal delivery was associated with decreased urethral pressure and decreased functional urethral length. These changes were not seen after cesarean section.

Persson et al. retrospectively reviewed obstetric and maternal risk factors for stress urinary incontinence.[3] Based in Sweden, three national registries were linked identifying women from 1932 to 1997 with a single mode of delivery and subsequent surgery for SUI. DM, BMI, age at first delivery, and birth weight portended a higher odds ratio. C-section, forceps and vacuum extraction, and episiotomy were negatively associated with incontinence surgery.

OR for elective C-section vs. noninstrumental vaginal delivery: 0.21 [0.13, 0.34]
OR for any C-section vs. noninstrumental vaginal delivery: 0.34 [0.23, 0.52]
OR nonoperative vaginal delivery vs. elective C-section: 4.76

OR for later incontinence surgery according to parity.

# children	Odds Ratio	95% Confidence Interval
0	1.0	N/A
1	3.57	3.13, 4.0
2	5.26	4.76, 5.88
3	6.67	5.88, 7.14
≥4	7.14	6.67, 8.33
All parous women	5.56	5.00, 6.25

Effect of BW of largest vaginally delivered infant on OR for later incontinence surgery.

	Instrumental	Delivery Included	Instrumental	Delivery Excluded
BW (gm)	Odds Ratio	95% CI	Odds Ratio	95% CI
< 3000	0.76	0.61, 0.99	0.74	0.58, 0.95
3000-3999	0.84	0.76, 0.93	0.83	0.74, 0.92
4000-4999	1.30	1.17, 1.45	1.30	1.17, 1.46
5000+	1.48	0.90, 2.44	1.77	1.08, 2.91

EPINCOT community based cohort study 1995-1997, Norway[4]
34755 community dwelling women
27936 completed questionnaire relating to incontinence
- 10509 (incomplete medical birth registry)
- 332 multifetal gestations
- 896 women the h/o vaginal and cesarean delivery
- 761 age 65 and older (incomplete verifiable birth records)
- 131 women who had delivered more than 4 children vaginally (no women in the cesarean group had delivered four children)

N = 15307 women who were either nulliparous, or had delivered only by one mode.

In the study population, incidence of

- Incontinence: 20.7%
- Stress: 12.2 %
- Urge: 1.8 %
- Mixed: 5.9 %

The data showed an association between stress incontinence and mode of delivery. Also, the prevalence of moderate to severe incontinence was greater in vaginal > cesarean > nulliparous patients. There was no difference between elective and non-elective Cesarean sections 15.4% v. 12.1%, p=0.50). Age, BMI, mode of delivery, years since last delivery, and gestational age at delivery were all associated risk factors for incontinence.

Odds Ratios for Incontinence according to Mode of Delivery.

	Any Incontinence	Moderate or Severe Incontinence	Stress Incontinence	Urge Incontinence	Mixed Incontinence
C-section vs. Nulliparas					
Univariable	1.7 [1.3-2.1]	1.6 [1.1-2.3]	1.6 [1.1-2.2]	1.5 [0.9-2.8]	1.9 [1.3-2.8]
Age-adjusted	1.5 [1.2-1.9]	1.4 [1.0-2.1]	1.4 [1.0-2.0]	1.4 [0.8-2.6]	1.7 [1.2-2.5]
Vaginal delivery vs. Nulliparas					
Univariable	2.8 [2.5-3.2]	3.3 [2.7-4.0]	3.7 [3.1-4.4]	1.4 [1.0-1.9]	2.6 [2.1-3.2]
Age-adjusted	2.3 [2.0-2.6]	2.6 [2.1-3.1]	3.0 [2.5-3.5]	1.2 [0.9-1.6]	2.1 [1.7-2.6]
Vaginal delivery vs. C-section					
Univariable	1.7 [1.4-2.1]	2.1 [1.5-2.9]	2.3 [1.7-3.1]	0.9 [0.5-1.5]	1.4 [1.0-1.9]
Multivariable[†]	1.7 [1.3-2.1]	2.2 [1.5-3.1]	2.4 [1.7-3.2]	0.9 [0.5-1.6]	1.3 [0.9-1.9]

[†]Analysis was adjusted for age, parity, years since last delivery, and BMI.

Dalhousie University, Halifax, Nova Scotia, Canada 1996-1998[5]
Prospective Study of Urinary Incontinence in primiparous women
Inclusion criteria

- nulliparity
- no history of urinary tract abnormalities
- no history of pelvic surgery
- no significant medical illness
- on no medications that would alter urinary tract function

Healthy, pregnant nulliparas were enrolled from 1/96 to 12/98. They completed a urinary questionnaire antepartum, 6 weeks postpartum, and 6 months postpartum.

Power analysis indicated 452 patients would need to complete the study. 484 primiparas completed 6 months of follow-up. 147 (25%) delivered by cesarean; 333 (56%) delivered by SVD; 115 (19%) delivered by FAVD.

Incidence and Risk for postpartum urinary incontinence in primiparas by mode of delivery in women continent before pregnancy.

Mode	% Incontinent at 6 weeks	RR 6 weeks	% Incontinent at 6 months	RR 6 month
SVD v. CS	23 v. 8	2.8 [1.5, 5.3]	22 v. 10	2.1 [1.1, 3.7]
FAVD v. SVD	35 v. 23	1.5 [1.1, 2.2]	33 v. 22	1.5 [1.0, 2.3]
FAVD v. CS	35 v. 8	4.3 [2.2, 8.2]	33 v. 10	3.1 [1.7,5.9][†]
CS (labor) v. CS (elective	9 v. 4	2.3 [0.3, 17.6]	12 v. 5	2.5 [0.3,18.5]
CS (2nd stage) v. CS (elective)	5 v. 4	1.2 [0.1, 12.2]	3 v. 5	0.6 [0.04,9.1]
CS (labor) v. SVD	9 v. 23	0.4 [0.2, 0.8]	23 v. 22	0.6 [0.3,1.0]

[†]Vacuum delivery showed similar risk.

Univariate analysis of obstetrical variables was performed. Birth weight was not a statistically significant factor; neither was duration of second stage or active first stage. P 0.04 was noted for duration of passive first stage.

Sze and colleagues at East Carolina University Brody School of Medicine evaluated the incidence of pelvic organ prolapse after vaginal and cesarean delivery.[6] From June 2000 to June 2001, all healthy nulliparous women with an uncomplicated singleton pregnancy, presented prior to 36 weeks, delivered at term, and consented, were enrolled. Each woman was examined upon enrollment and at six weeks postpartum. Pelvic support was graded using the International Continence Society staging system. 101 women enrolled, 7 were lost to follow-up. 43 of 94 women had prolapse at their 6 week postpartum visit. 13 of 41 (32%) who had SVD and 9 of 26 (35%) of women who had C-section during active labor developed new prolapse. (p=0.805). There was no statistically significant difference in new prolapse with respect to white or black race (p=0.363).

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[1] Handa VL, Harris TA, Ostegard DR. Protecting the Pelvic Floor: Obstetric Management to Prevent Incontinence and Pelvic Organ Prolapse. Obstet Gynecol 1996; 88: 470-8.

[2] Meyer A, Schreyer A, de Grandi P, Hohlfeld P. The Effects of Birth on Urinary Incontinence Mechanisms and Other Pelvic Floor Characteristics. Obstet Gynecol 1998; 92: 613-8.

[3] Persson J, Wolner-Hanssen P, Rydhstroem H. Obstetric Risk Factors for Stress Urinary Incontinence: A Population-based study. Obstet Gynecol 2000; 96: 440-5.

[4] Rortveit G, Daltveit AK, Hannestad YS, Hunskaar S. Urinary Incontinence after Vaginal Delivery or Cesarean Section. NEJM 2003; 348: 900-7.

[5] Farrell SA, Allen VM, Baskett TF. Parturition and Urinary Incontinence in Primiparas. Obstet Gynecol 2001; 97:350-6.

[6] Sze EHM, Sherard GB, Dolezal JM. Pregnancy, Labor, Delivery, and Pelvic Organ Prolapse. Obstet Gynecol 2002; 100: 981-6.