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A randomized trial of the effects of coached vs uncoached maternal pushing during the second stage of labor on postpartum pelvic floor structure and function

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KEY WORDS
Coached pushing
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Objective: The purpose of this study was to determine if refraining from coached pushing during the second stage of labor affects postpartum urogynecologic measures of pelvic floor structure and function.

Study design: Nulliparous women at term were randomized to coached (n = 67) vs uncoached (n = 61) pushing. At 3 months' postpartum women underwent urodynamic testing, pelvic organ prolapse examination (POPQ), and pelvic floor neuromuscular assessment.

Results: Urodynamic testing revealed decreased bladder capacity (427mL vs 482 mL, $P = .051$) and decreased first urge to void (160 mL vs 202 mL, $P = .025$) in the coached group. Detrusor overactivity increased 2-fold in the coached group (16% vs 8%), although this difference was not statistically significant ($P = .17$). Urodynamic stress incontinence was diagnosed in the coached group in 11/67 (16%) vs 7/61 (12%) in the uncoached group ($P = .42$).

Conclusion: Coached pushing in the second stage of labor significantly affected urodynamic indices, and was associated with a trend towards increased detrusor overactivity.

Vaginal delivery is associated with postpartum urinary and anal incontinence,[1] and with the development of pelvic floor dysfunction over a woman's lifetime.[2-4] It is estimated that 2 vaginal deliveries increase the risk of developing urinary incontinence 2-fold,[5] and increase the risk of surgery for pelvic organ prolapse 8-fold.[6]

Specific obstetric risk factors for postpartum and long-term pelvic floor dysfunction remain controversial. Macrosomia, prolonged second stage of labor, episiotomy, anal sphincter laceration, epidural analgesia, forceps, and oxytocin use have all been proposed as risk factors but have not been definitively been proven to be so.

One potentially modifiable risk factor which affects virtually all American women delivering vaginally is the practice of actively coaching expulsive efforts during the second stage of labor. Although several controlled trials have been published on second stage coaching that address the effects of this practice on infant outcome

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and duration of labor, none have addressed the impact of second stage management on subsequent pelvic floor function measured using established techniques such as urodynamic testing and pelvic organ prolapse examination. The goal of this study was to conduct a randomized, controlled trial of the effects of coached vs uncoached maternal pushing during the second stage of labor on postpartum pelvic floor structure and function.

Material and methods

All nulliparous women who presented to Parkland Hospital from June 1, 2000 to August 31, 2002 in spontaneous active labor with uncomplicated pregnancies between 36 and 41 weeks' gestation were asked to participate in an Institutional Review Board–sanctioned study of coached vs uncoached pushing during the second stage of labor. Eligible women were those with regular uterine contractions, cervical dilatation of at least 4 cm, and fetuses in cephalic presentation. Women with a previous history of urinary incontinence, anal incontinence, pelvic organ prolapse, any known complication of pregnancy, or an estimated fetal weight greater than 4000 g were excluded.

Consent was obtained upon admission in labor. The first stage of labor was managed according to a written protocol by certified nurse midwives under the supervision of house staff and attending obstetricians.[7] Consented women were randomized to coached or noncoached pushing when first identified to be in the second stage of labor, defined as 10 cm of cervical dilatation. Randomization was accomplished with a computer-generated randomization scheme in blocks of 10 patients. Assignment was masked to the providers by use of opaque envelops. Patients who received oxytocin or epidural analgesia before the second stage were not randomized.

Beginning with onset of the second stage of labor, women randomized to the coached arm received standardized instruction on pushing during contractions. Pushing, using a closed glottis, was coached by certified nurse midwives, and proper ventilation encouraged between contractions. Women randomized to uncoached pushing were supervised by certified nurse midwives but not given specific instructions on pushing technique. They were told to "do what comes natural." The protocols for coached and uncoached pushing are shown in Table I. All nurse midwives participating in this trial attended training sessions to ensure a standardized approach to both arms of the study. Forceps delivery was only permitted for a prolonged second stage of labor ($\geq$2 hours without epidural analgesia) or fetal heart rate abnormalities. Episiotomy use was at the discretion of the certified nurse midwife or attending obstetrician.

Three months' postpartum, patients underwent a standardized pelvic floor evaluation and urodynamic testing by 2 urogynecology nurse practitioners blinded to the obstetric management. Pelvic floor structure was assessed using the pelvic organ prolapse quantification (POPQ) examination.[8] Levator ani tone and contraction, and anal sphincter tone and contraction, were digitally assessed with the Oxford grading system.[9] Anal sphincter integrity was assessed with digital palpation. Bulbocavernosus and anal wink reflexes were tested bilaterally. Pelvic floor squeeze pressure was evaluated using a Hollister® (Hollister Inc, Libertyville, Ill) balloon pressure sensor which was zeroed to atmospheric pressure. It was inserted into the vaginal vault and filled with 15 mL of air. Squeeze and hold maneuvers were performed, and the median pressure of contraction was determined. Urethral hypermobility was determined by Q-tip testing. A sterile Q-tip with lidocaine jelly was inserted transurethrally into the bladder, and the resting and straining angles were measured with an orthopedic goniometer.

Standardized urodynamic testing was performed using a Laborie Ascend® (Laborie Medical Technologies, Williston, Vt) multichannel urodynamic system and Millar® (Millar Instruments, Inc., Houston, Tex) micro-tip urodynamic catheters. Urodynamic testing was performed with patients in the sitting position on a Sonesta® (Sonesta, Dallas, Tex) urodynamic chair. Filling cystometry was performed at a rate of 100 mL/min. First urge to void and bladder capacity were determined. Standardized cough and Valsalva maneuvers were performed at 200 mL to ascertain urinary leakage, and leak point pressures were obtained. If no leakage occurred at 200 mL, cough was performed at 100-mL intervals during filling until bladder capacity was reached. After completion of filling cystometry, a voiding study was performed over a uroflow pressure

Table I Techniques used for coached and uncoached pushing

Coached group	
Step 1	Head of bed up 30°.
Step 2	Position patient, as she desires, on her back or either side.
Step 3	Coach patient to pull back on both knees and tuck her chin while the provider or partner supports the legs.
Step 4	Coach the patient to take a deep breath and hold during the peak of a contraction then bear down and push for 10 seconds; repeat this as long as the contraction continues.
Uncoached group	
Step 1	Head of bed up 30°.
Step 2	Position patient, as she desires, on her back or either side.
Step 3	The patient should be told simply to "do what comes natural or whatever the patient feels the urge to do while in bed."

Table II Demographic factors in 128 women randomized to coached vs uncoached pushing during the second stage of labor

	Coached (n = 67)	Uncoached (n = 61)	*P* value
Race			.398
Black	3 (4)	2 (3)	
White	2 (3)	0	
Hispanic	61 (91)	59 (97)	
Other	1 (1)	0	
Age (y)	21.2 ± 3.4	21.2 ± 3.9	.955
Weight (lbs)	152.8 ± 23.9	155.2 ± 22.3	.559
Height (in)	61.3 ± 2.6	61.9 ± 2.5	.268
BMI (kg/m^2)	28.4 ± 4.0	28.5 ± 3.8	.890
EGA (wk)	39.7 ± 0.9	40.0 ± 0.9	.093
Birth weight (g)	3315 ± 377	3299 ± 346	.802

All data shown as n (%) or mean ± standard deviation.

Table III Selected obstetric characteristics in women coached to push during the second stage of labor compared with uncoached women

	Coached	Uncoached	*P* value
Prolonged second stage (>2 hrs)	3/67 (4)	5/61 (8)	.385
Episiotomy	15/67 (22)	13/61 (21)	.883
3rd- or 4th-degree anal sphincter laceration	2/67 (3)	5/61 (8)	.195
Macrosomia	3/67 (4)	1/61 (2)	.357
Epidural analgesia	2/67 (3)	2/61 (3)	.924
Forceps delivery	2/67 (3)	3/61 (5)	.573
Oxytocin augmentation	5/67 (7)	10/61 (16)	.117

Data shown as n (%).

transducer. Flow rate and detrusor pressure at peak flow were determined. After this, the bladder was refilled to 200 mL, and urethral pressure profile was performed with the Millar dual sensor catheter placed at 9 o'clock in relation to the urethral lumen. An automatic puller arm was used to withdraw the catheter at 1 mm/sec. Three pulls were performed, and an average value for maximum urethral closure pressure and functional urethral length was calculated. Detrusor overactivity and urodynamic stress incontinence were determined using the definitions of the International Continence Society.[10]

For the purposes of identifying a primary study end point for this trial, maximum urethral closure pressure was used as an objective measure of urethral function on the premise that this measure could reveal neuromuscular injury. The sample size estimate was based upon maximum urethral closure pressure. A mean normal maximum urethral closure pressure of 85 cm H_2O was assumed,[11] with a standard deviation of 18 cm H_2O. Based upon a 10 cm H_2O reduction in maximum urethral closure pressure in the coached group over the uncoached group, a sample size of 53 nulliparous women would be necessary in each arm for 80% power and a significance level of 0.05 (two-sided). We estimated that approximately 50% of the women enrolled would be available for urogynecologic evaluation 3 months after delivery.

Statistical evaluation was performed using Pearson chi-square for categorical measures and Student *t* test for continuous variables. The continuous measures judged to not be statistically normal (Table IV) were evaluated using the Wilcoxon rank-sum test. The analysis was by intent to treat.

Results

A total of 1534 consecutive women presenting in labor were screened for participation in this study. Of these, 988 women consented and 546 women declined study participation. At the onset of the second stage of labor, 325 women were randomized to coached or uncoached pushing. The remainder of the consented women were not eligible for randomization because of epidural analgesia (n = 345), labor complications (n = 198), and time of onset of second stage undetermined (n = 120). Of the 325 randomized women, 128 (coached n = 67, uncoached n = 61) returned for the 3-month postpartum visit for urogynecologic testing. The remaining 197 women included 13 who refused a testing appointment, 91 who did not show up for their appointment, 70 who we were unable to contact, and 23 protocol violations.

All women delivered vaginally in the cephalic presentation. The mean age was 21.2 ± 3.6 years, BMI was 28.5 ± 3.9, and birth weight was 3307 ± 361 g. Ninety-four percent was Hispanic, 4% African American, and 2% Caucasian. There were no statistically significant demographic differences between the study groups (Table II). Table III is a comparison of obstetric factors between the 2 study groups. No significant differences were found in prolonged second stage of labor, episiotomy, anal sphincter laceration, macrosomia, epidural, forceps, or oxytocin use.

The urodynamic testing results are presented in Table IV. The first urge to void was significantly decreased in the coached group ($P = .025$). Bladder capacity was also decreased in the coached group ($P = .051$). There were no differences in detrusor pressure at peak flow, functional urethral length, and maximum urethral closure pressure. Mean maximum urethral closure pressure in the coached and uncoached groups were 83 and 90 cm H_2O, respectively ($P = .15$). Positive Valsalva leak point pressures were obtained in 8/66 (12%) in the coached group and 2/59 (3%) in the uncoached group ($P = .072$). Leak point pressures ranged from 64 to 175 cm H_2O. Cystometrogram in the coached group showed 11/67 (16%) with detrusor overactivity vs 5/61 (8%) in the uncoached group ($P = .16$). Urodynamic stress incontinence was present in the coached group in 11/67 (16%) vs 7/61 (12%) in the uncoached group ($P = .42$).

Table IV Urodynamic measurements in coached vs uncoached women

	Coached	Uncoached	*P* value
First urge to void (mL)	160.6 ± 84.9	202.1 ± 104.1	.025
Bladder capacity (mL)	427.3 ± 94.4	481.9 ± 137.7	.051
Maximum urethral closure pressure (cm H_20)	83.0 ± 24.3	89.6 ± 27.4	.264
Functional urethral length (cm)	2.1 ± 2.0	2.0 ± 2.5	.548
Positive Valsalva leak point pressure	8/66 (12)	2/59 (3)	.072
Maximum flow rate (mL/sec)	24.4 ± 31.6	24.6 ± 12.4	.231
Detrusor pressure at peak flow (cm H_20)	28.6 ± 14.3	38.1 ± 102.1	.104
Detrusor overactivity	11/67 (16)	5/61 (8)	.170
Urodynamic stress incontinence	11/67 (16)	7/61 (12)	.443

Data shown as n (%) or mean ± standard deviation.

Table V POPQ measurements in cm for coached (bold) women compared with uncoached women

Aa	Ba	C
−1.4	**−1.4**	**−6.1**
−1.4	−1.4	−5.9
gh	**Pb**	**tvl**
3.5	**4.1**	**9.4**
3.6	4.0	9.4
Ap	**Bp**	**D**
−1.8	**−1.8**	**−8.0**
−2.0	−2.1 (*P* = .048)*	−8.0

* All *P* values not significant except Bp.

The results of POPQ examination are presented in Table V. Point Bp showed significantly more descent in the coached group vs the uncoached group (−1.8 ± 1.0 vs −2.1 ± 1.0, $P = .048$); however, there were no other differences. Table VI shows the results of the neuromuscular examination in both groups. Bulbocavernosus and anal wink reflexes, anal sphincter integrity and tone, squeeze pressure, and levator ani contraction were unchanged between groups. Left levator ani tone was decreased in the uncoached group ($P = .044$).

Table VI Neuromuscular measurements of the pelvic floor

	Coached	Uncoached	*P* value
Anal sphincter intact	66/66 (100)	61/61 (100)	1.000
Bulbocavernous positive			
Right	57/65 (88)	48/60 (80)	.241
Left	56/65 (86)	49/60 (82)	.494
Anal wink positive			
Right	59/64 (92)	53/60 (88)	.468
Left	57/64 (89)	52/59 (88)	.872
Levator ani tone			
Right	4.4 ± 1.0	4.4 ± 1.1	.722
Left	4.7 ± 0.5	4.5 ± 0.8	.044
Levator ani contraction			
Right	3.7 ± 1.5	3.7 ± 1.3	.434
Left	3.8 ± 1.4	3.6 ± 1.2	.159
Anal sphincter tone			
Right	5.0 ± 0.2	4.9 ± 0.3	.248
Left	4.3 ± 1.3	4.3 ± 1.2	.862
Squeeze pressure (cm H_20)	11.1 ± 8.4	10.8 ± 7.7	.875
Q-tip resting (degrees)	−5.3 ± 11.1	−2.8 ± 12.5	.125
Q-tip straining (degrees)	38.5 ± 27.1	39.2 ± 27.8	.929

Data shown as n (%) or mean ± standard deviation.

Comment

Vaginal delivery is associated with short- and long-term pelvic floor dysfunction. Elective cesarean delivery for prevention is currently being widely discussed; however, adoption of this strategy would subject many women who will never develop pelvic floor dysfunction to a surgical procedure that is not without risk.[12] A better approach to the prevention of pelvic floor dysfunction would be to identify women at risk or identify modifiable obstetric risk factors in the labor and delivery process.

In this study, we found that first urge to void, bladder capacity, and POPQ point Bp were all negatively impacted by coached pushing. Additionally, there was a trend towards increased detrusor overactivity. These findings, in aggregate, suggest that the practice of routine coached pushing during the second stage of labor may have harmful effects on the pelvic floor.

During vaginal delivery the pelvic floor is exposed to compression and extreme pressures from the fetal head and maternal expulsive efforts. In a study of 42 women with spontaneous occiput anterior vaginal deliveries, it was found that the average peak pressure on the fetal head and pelvic floor during bearing down efforts was 238.2 ± 82.4 mm Hg, and the maximum pressure in one patient was 403.0 mm Hg.[13] With uncoached pushing, bearing down does not occur until uterine contractions are well established and the urge to push is present. There are normally several short bearing down efforts per contraction with breath holding for 5 to 6 seconds. In coached pushing, the mother is alerted to begin pushing as soon as a contraction is noted by the coach, and she is encouraged to push for 10 seconds, take a deep breath, and push

again.[14] Coached pushing could potentially increase the amount of pressure on the pelvic floor with subsequent deleterious effects.

This study has several strengths. It was a randomized trial with well-controlled study groups. All women enrolled had uncomplicated pregnancies. Potentially confounding variables such as epidural analgesia and oxytocin augmentation of labor were excluded, producing a cohort of patients in which coached vs uncoached pushing could be accurately compared. Labor management was protocol driven, which facilitated study groups with similar labor interventions. This study represents a homogenous population of nulliparous Hispanic women. We believe this is a strength of the study, although it may limit generalizabilty to the overall population. Weaknesses of the study were the short-term follow-up and the possibility that the postpartum changes we observed could resolve over time. Additionally, this was an open trial in which blinding of the midwives could not occur. However, every effort was made to ensure that the providers were compliant with the second stage protocols. We expected low compliance with follow-up in our patient population and, therefore, planned the study with an expected 50% drop-out rate before the 3-month visit. This study was powered to detect differences in MUCP, a marker of neuromuscular damage. A much larger study would have been necessary to detect significant differences in detrusor overactivity or urodynamic stress incontinence. For instance, if postpartum urodynamic stress incontinence occurs at the rate we found in this study (coached 16%, uncoached 12%), we would need 1180 patients in each arm of the study to achieve 80% power to recognize such a difference under a two-sided test of significance 0.05.

Coached pushing is a potentially modifiable obstetric practice that affects virtually all American women delivering vaginally. Given that several randomized controlled trials have not identified maternal or fetal benefits to this practice,[15-18] and coupled with our evidence that urogynecologic indices may be negatively impacted, it seems prudent to recommend that coached pushing during the second stage of labor be limited to specific indications such as prolonged second stage or nonreassuring fetal heart rate.

References

1. Chaliha C, Kalia V, Stanton SL, Monga A, Sultan AH. Antenatal prediction of postpartum urinary and fecal incontinence. Obstet Gynecol 1999;94:689-94.
2. Milsom I, Ekelund P, Molander U, Arvidsson L, Areskoug B. The influence of age, parity, oral contraception, hysterectomy and menopause on the prevalence of urinary incontinence in women. J Urol 1993;149:1459-62.
3. Thom DH, Brown JS. Reproductive and hormonal risk factors for urinary incontinence in later life: a review of the clinical and epidemiologic literature. J Am Geriatr Soc 1998;46:1411-7.
4. Foldspang A, Mommsen S, Lam GW, Elving L. Parity as a correlate of adult female urinary incontinence prevalence. J Epidemiol Community Health 1992;46:595-600.
5. Rortveit G, Daltveit AK, Hannestad YS, Hunskaar S. Vaginal delivery parameters and urinary incontinence: the Norwegian EPINCONT study. Am J Obstet Gynecol 2003; 189:1268-74.
6. Mant J, Painter R, Vessey M. Epidemiology of genital prolapse: observations from the Oxford Family Planning Association Study. BJOG 1997;104:579-85.
7. Cunningham FG, Gant NF, Leveno KJ, Gilstrap LC, Hauth JC, Wensstrom KD. Williams obstetrics, 21st ed. New York, NY: McGraw Hill; 2001. p. 446.
8. Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JO, Klarskov P, et al. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. Am J Obstet Gynecol 1996;175:10-7.
9. Laycock J, Haslam J. Therapeutic management of incontinence and pelvic pain: pelvic organ disorders. London: Springer-Verlag; 2002. p. 52.
10. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-Committee of the International Continence Society. Neurourol Urodyn 2002; 21:167-78.
11. van Geelen JM, Lemmens WA, Eskes TK, Martin CB Jr. The urethral pressure profile in pregnancy and after delivery in healthy nulliparous women. Am J Obstet Gynecol 1982;144:636-49.
12. Nygaard I, Cruikshank DP. Should all women be offered elective cesarean delivery? Obstet Gynecol 2003;102:217-9.
13. Rempen A, Kraus M. Measurement of head compression during labor: preliminary results. J Perinat Med 1991;19:115-20.
14. Sampselle CM, Hines S. Spontaneous pushing during birth. Relationship to perineal outcomes. J Nurse Midwifery 1999; 44:36-9.
15. Parnell C, Langhoff-Roos J, Iversen R, Damgaard P. Pushing method in the expulsive phase of labor. A randomized trial. Acta Obstet Gynecol Scand 1993;72:31-5.
16. Fitzpatrick M, Harkin R, McQuillan K, O'Brien C, O'Connell PR, O'Herlihy C. A randomised clinical trial comparing the effects of delayed versus immediate pushing with epidural analgesia on mode of delivery and faecal continence. BJOG 2002;109:1359-65.
17. Fraser WD, Marcoux S, Krauss I, Douglas J, Goulet C, Boulvain M. Multicenter, randomized, controlled trial of delayed pushing for nulliparous women in the second stage of labor with continuous epidural analgesia. The PEOPLE (Pushing Early or Pushing Late with Epidural) Study Group. Am J Obstet Gynecol 2000;182:1165-72.
18. Enkin M, Keirse MJNC, Neilson J, Crowther C, Duley L, Hodnett E, et al. A guide to effective care in pregnancy and childbirth. Oxford University Press; 2000.