

Fecal and urinary incontinence after vaginal delivery with anal sphincter disruption in an obstetrics unit in the United States

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OBJECTIVE: The purpose of this study was to estimate the incidence of urinary and bowel incontinence in relation to anal sphincter laceration in primiparous women and to identify factors that are associated with anal sphincter laceration in a unit that uses primarily midline episiotomy.

STUDY DESIGN: From January 1, 1997, to March 30, 2000, 2941 questionnaires concerning pelvic floor function 6 months after delivery were mailed to primiparous women who were delivered vaginally at the University of Michigan Medical Center. Charts were reviewed for 2858 deliveries to assess the use of episiotomy and the degree of perineal trauma, along with demographic and pertinent delivery variables. There were 943 women who completed the urinary function questionnaire and 831 women who completed the bowel function questionnaire. Univariate analysis was performed on all covariates. Multiple logistic regression was used for the analysis of the presence of third- or fourth-degree lacerations as the outcome.

RESULTS: Nineteen percent of the women who completed the survey had sustained third- or fourth-degree lacerations during childbirth. The women in the sphincter laceration group were more likely (23.0%) to have bowel incontinence than the women in the control group (13.4%) ($P < .05$). The incidence of worse bowel control was nearly 10 times higher in women with fourth-degree lacerations (30.8%) compared with women with third-degree lacerations (3.6%, $P < .001$). Macrosomia (odds ratio, 2.19; 95% CI, 1.61, 2.99), forceps-assisted delivery (odds ratio, 4.75; 95% CI, 3.43, 6.57), and vacuum-assisted delivery (odds ratio, 3.51; 95% CI, 2.64, 4.66) were associated with higher risks of third- and fourth-degree lacerations. Midline episiotomy (odds ratio, 2.24; 95% CI, 1.81, 2.77), but not mediolateral (odds ratio, 0.66; 95% CI, 0.375, 1.19), episiotomy was associated with anal sphincter lacerations. More than one half of the women had new onset of urinary incontinence after delivery and reported several lifestyle modifications to prevent leakage.

CONCLUSION: Women with third- and fourth-degree lacerations were more likely to have bowel incontinence than women without anal sphincter lacerations. Fourth-degree lacerations appear to affect anal continence greater than third-degree lacerations. (*Am J Obstet Gynecol* 2003;189:1543-50.)

Key words: Anal incontinence, urinary incontinence, perineal lacerations, vaginal delivery

Vaginal delivery has proved to have many long-term sequelae, which include urinary and fecal incontinence.¹⁻⁵ Many factors (such as primiparity, macrosomia, a prolonged second stage of labor, and instrument-assisted delivery) have been associated with an increased risk of both urinary and fecal incontinence.^{1,3-6} Specifically, third- or fourth-degree lacerations are known risk factors for the development of fecal incontinence.⁷⁻⁹

Although there have been significant contributions to our understanding of the anatomic, functional, and obstetric factors that are relevant to this condition during the past 20 years, most of these data have come from European obstetrics units at which mediolateral episiotomy is used almost exclusively.¹⁰⁻¹³ Practice in the United States, although not uniform, tends to favor midline episiotomy. Because a sphincter laceration that is associated with a midline defect is anatomically different than a laceration that is associated with mediolateral episiotomy, the number of symptomatic women and the degree of symptoms may not be the same in these two settings.^{6,14,15} Studies suggest that midline episiotomies are more likely to extend into the anal sphincters and result in increased incontinence to gas and stool and that mediolateral episiotomies are protective against sphincter lacerations.^{13,16} The importance in establishing which episiotomy method is less likely to cause anal sphincter

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injury lies in the fact that the repair of third- and fourth-degree lacerations is ineffective in preventing anal incontinence in 40% to 50% of women.¹⁶⁻¹⁹ Knowing the frequency of symptomatic women and the factors that are associated with sphincter lacerations in a unit in the United States would provide information relevant to obstetrics in the United States.

The current analysis was carried out to determine the proportion of primiparous women who were delivered vaginally, who completed a symptoms questionnaire, and who had problems with urinary and fecal control, how these symptoms related to obstetric variables, especially third- and fourth-degree lacerations.

Methods

This retrospective study was performed at the University of Michigan Medical Center between January 1, 1997, and March 30, 2000, after approval by the Institutional Review Board. We mailed a brief questionnaire about pelvic floor symptoms after vaginal delivery as part of recruitment for a study of stress urinary incontinence after the first vaginal birth to primiparous women who were delivered vaginally. Questionnaires concerning bowel and bladder function were mailed to the women at 6 months after delivery. Inclusion criteria were primiparity, vaginal delivery, no history of urinary or bowel incontinence before pregnancy, no history of urinary tract abnormalities or pelvic surgery, no significant medical illness, and no medication use that could alter urinary or bowel function. Obstetric records were obtained and reviewed for 2941 women; 83 women were excluded from analysis for the following reasons: 9 women had both vacuum- and forceps-assisted delivery, 25 women had pudendal nerve block that theoretically might affect nerve function, and 49 women had incomplete or missing charts.

The questionnaire had four main domains. Women were asked to compare their current bowel function to bowel function before pregnancy and to rate it as the same, slightly worse, worse and a minor inconvenience, worse and an occasional major problem, or worse and a major problem. The next sections asked the women to assess their current bladder control compared with bladder control before pregnancy. They were asked to categorize their bladder control as the same as before pregnancy, slightly worse but not a problem, worse and a minor inconvenience, worse and an occasional major problem, or worse and a major problem. The participants were then asked to choose among symptoms that best described their bladder control problem: (1) When I cough, sneeze, or lift something heavy, I wet myself; (2) I am not able to wait before going to the bathroom once my bladder is full; (3) If I wait too long to empty my bladder, I may have an accident; or (4) I may leak urine if I hear running water. Additionally, they were asked whether they

altered daily activities because of incontinence (such as wearing a pad, voiding more frequently, decreasing fluid intake, or paying more attention to where there are restrooms). Delivery records and medical charts were reviewed to examine a number of independent variables for their association with anal sphincter lacerations. The degree of perineal laceration was defined clinically at the time of delivery, and subjects were divided into two groups on the basis of the presence or absence of anal sphincter laceration. The presence of first-degree (extending into perineal skin), second-degree (extending into perineal skin and perineal body), third-degree (extending through some or the entire external anal sphincter), and fourth-degree (extending into anal mucosa) laceration was documented. Subjects in the anal sphincter laceration group had third- or fourth-degree lacerations; patients in the control group had an intact perineum, first-degree laceration, or second-degree laceration.

Factors that were recorded included maternal age, the number of previous pregnancies, gestational age, prolonged second stage of labor, macrosomia (birth weight >4000 g), forceps- and vacuum-assisted delivery, episiotomy type (midline or mediolateral), epidural anesthesia, and pitocin augmentation.

Univariate analysis was performed for all covariates, which included maternal age at delivery in years, the weight of baby at delivery in grams (defined as >4000 g), the use of anesthesia at delivery (epidural), the use of episiotomies (median or mediolateral), the presence of operative delivery (forceps or vacuum), and the length of the second stage of labor in minutes (defined as >120 minutes). Multiple logistic regression was used for analysis with the presence of third- and fourth-degree lacerations as the outcome. Stepwise procedures were performed to identify the postparsimonious model. The final logistic model included all covariates described and was controlled for gestational age in weeks, number of previous pregnancies (0, 1, 2, 3+), and oxytocin use during labor. Likelihood ratio tests were performed on each covariate and on the null versus extended models. Results are reported as odds ratio (OR) with 95% CI. A probability value of <.05 was considered to be significant; probability values have been presented when appropriate.

Results

A total of 2858 women were evaluated in the study; patients were separated into two groups on the basis of degree of perineal laceration. Five hundred six of the women (17.7%) sustained third- or fourth-degree lacerations and were in the anal sphincter laceration group. The remaining group of 2352 women without sphincter lacerations was composed of women with no lacerations or with first- or second-degree lacerations.

As seen in Table I, the results reveal that women with anal sphincter lacerations had a higher mean age (28.62

Table I. Descriptive characteristics and comparison of groups with and without anal sphincter laceration

Characteristic	Total sample (n = 2858)	No sphincter laceration group (n = 2352)	Sphincter laceration group (n = 506)	P value
Mean maternal age (y)	27.34	27.04	28.62	< .001
Mean gestational age (wk)	39.35	39.31	39.54	.002
Mean length of second stage of labor (min)	102.66	95.77	134.30	< .001
Mean weight of baby (g)	3389.49	3356.09	3545.54	< .001
Second stage of labor >120 min		725 (30.82%)	251 (49.60%)	< .001
Weight >4000 g		182 (7.74%)	80 (15.81%)	< .001
Delivery type				
Normal spontaneous vaginal delivery		2027 (86.18%)	283 (55.93%)	< .001
Forceps		141 (5.99%)	107 (21.25%)	< .001
Vacuum		184 (7.82%)	116 (22.92%)	< .001
Anesthesia (n)		1590 (67.60%)	389 (76.88%)	< .001
Episiotomy (n)				
Median		665 (28.27%)	266 (52.57%)	< .001
Mediolateral		73 (3.10%)	20 (3.95%)	< .001
Oxytocin use (n)		1122 (47.70%)	248 (49.01%)	.593

years) than women without sphincter lacerations (27.04 years, $P < .001$). Additionally, fetal characteristics (such as older gestational age and macrosomia) were statistically significant. Of the babies in the anal sphincter laceration group, 15.8% weighed ≥ 4000 g compared with 7.7% of the babies who were born to mothers without sphincter lacerations ($P < .001$). Prolonged duration of the second stage of labor was also more common in the anal sphincter laceration group. Specifically, nearly one half of women (49.6%) in the anal sphincter laceration group had a second stage of labor that exceeded 120 minutes compared with 30.8% of the women without sphincter lacerations ($P < .05$).

Delivery mode was a significant factor; 44.2% of the women in the sphincter laceration group had instrument-assisted births compared with only 13.8% of women in the control group ($P < .001$). Vacuum-assisted deliveries occurred in 22.9% of births in the anal sphincter laceration group compared with 7.8% of the deliveries with no sphincter lacerations ($P < .001$). Forceps-assisted deliveries occurred in 21.3% of births in the laceration group compared with 6.0% in the control group ($P < .001$).

Midline episiotomy was more common in the laceration group by descriptive comparison. In the anal sphincter laceration group, 52.7% of women had midline episiotomies compared with 28.7% of women in the group without sphincter laceration ($P < .001$). In contrast, only 4.0% of women with anal sphincter lacerations had mediolateral episiotomies compared with 3.1% of women without sphincter lacerations ($P < .001$). No statistically significant association was observed between oxytocin use ($P = .593$) and anal sphincter laceration.

Adjusted OR analysis showed that fetal macrosomia was associated with an increased incidence of anal sphincter

lacerations (OR, 2.19; 95% CI, 1.61, 2.99). Strong associations were seen with both forceps-assisted delivery (OR, 4.75; 95% CI, 3.43, 6.57) and vacuum-assisted delivery (OR, 3.51; 95% CI, 2.64, 4.66). OR-adjusted analysis (Table II) found that midline episiotomy (OR, 2.24; 95% CI, 1.81, 2.77) revealed a significant association with anal sphincter lacerations, although mediolateral episiotomy (OR, 0.66; 95% CI, 0.375, 1.19) appeared to be protective against sphincter laceration in our analysis. The covariates in the model were tested for collinearity but were shown to be independent factors. The final model was tested for goodness-of-fit with the Hosmer-Lemeshow test ($P = .386$) because there were a large number of unique patterns of covariates in relation to the sample size.

Of the 2858 women who were enrolled in the study, 943 women (33%) completed questionnaires that pertained to bladder control. Overall, more than one half of the women reported slightly worse or worse bladder function after pregnancy. A summary of the effect of delivery on bladder control and lifestyle modifications as the result of urinary incontinence is seen in Table III. Of the women who had bladder incontinence, stress symptoms were more common, being reported in 21.3% of women overall. Urge incontinence symptoms were reported in 16.2% of the respondents, although 14.6% of the respondents reported both stress and urge incontinence symptoms.

Questions concerning bowel control were completed by 831 of the women (29%). Of these, 165 women (19.9%) had sustained third- or fourth-degree lacerations during childbirth. Overall, 21.7% of women reported slightly worse or worse bowel control since delivery. Women with anal sphincter lacerations had more difficulty with bowel control. In the sphincter laceration group, 29.7% of the women reported slightly worse or

Table II. Crude and adjusted OR analysis of anal sphincter laceration

Characteristic	Crude OR			Adjusted OR		
	OR	95% CI	P value	OR	95% CI	P value
Age	1.05	1.04, 1.19	< .001	1.04	1.02, 1.06	< .001
Second stage of labor						
<120 min	1.0					
≥120 min	2.21	1.81, 2.68	< .001	1.20	0.96, 1.50	.107
Weight of baby						
<4000 g	1.0					
≥4000 g	2.23	1.68, 2.97	< .001	2.19	1.61, 2.99	< .001
Delivery type:						
Normal spontaneous vaginal delivery	1.0					
Forceps	5.44	4.11, 7.19	< .001	4.75	3.43, 6.57	< .001
Vacuum	4.52	3.47, 5.88	< .001	3.51	2.64, 4.66	< .001
Anesthesia						
No epidural	1.0					
Epidural	1.59	1.27, 1.99	< .001	1.20	0.937, 1.53	.150
Episiotomy						
None	1.0					
Median	2.93	2.40, 3.58	< .001	2.24	1.81, 2.77	< .001
Mediolateral	2.01	1.20, 3.36	.008	.666	0.375, 1.19	.017

Table III. Prevalence and lifestyle modifications for urinary incontinence

	No. of women	Percentage
Bladder control		
Same	376	39.87
Slightly worse	307	32.56
Worse minor inconvenience	205	21.74
Worse occasional inconvenience	51	5.41
Worse, major problem	4	0.42
TOTAL	943	100
Lifestyle modification		
Pay more attention to restrooms	154	16.31
Wear pad in case of leaking	103	10.91
Empty bladder to avoid leaking	173	18.33
Decrease fluid intake to avoid full bladder	58	6.14
Other	95	10.06
TOTAL	583	61.75

worse bowel control compared with 19.4% of the women without sphincter lacerations. Similarly, 7.9% of the women in the sphincter group reported worse bowel control compared with 6.0% of the women without lacerations. The Figure shows the incidence of worsening bowel function as it relates to the severity of perineal laceration. Overall, third-degree lacerations, which occurred in 16.7% of the women, were more common compared with fourth-degree lacerations, which were present in 3.6% of the women. A striking finding is that the incidence of worse bowel function is nearly 10 times higher in women with fourth-degree lacerations compared with women with third-degree lacerations. Of the women with fourth-degree lacerations, 30.8% reported

worse bowel control compared with 3.6% of women with third-degree lacerations ($P < .001$).

Comment

Our study confirms previous reports showing a relationship between obstetric variables and the risk of the development of urinary incontinence after vaginal delivery. New information includes the high incidence of urge incontinence after delivery in this young, primiparous population. Three of five primiparous women (60.1%) who responded to the questionnaire had slightly worse or worse bladder control after pregnancy. This figure is higher than the findings of Farrel et al,¹ who found that 22% of women with spontaneous vaginal deliveries and 33% of women with forceps-assisted deliveries had urinary incontinence. The high prevalence of urinary incontinence symptoms after pregnancy that was reported in our study is a reflection of study design. Women with urinary incontinence were probably more likely to return the questionnaire than the women without symptoms. Our findings agree with previous reports that associated stress incontinence with the trauma of childbirth.²⁰ We were surprised to note that 16.2% of women reported urge incontinence symptoms alone. Furthermore, 14.6% of women reported mixed stress and urge incontinence symptoms. These findings suggest a mechanism of pelvic floor denervation and mechanical tissue and of muscle damage that leads to both symptoms stress and urge incontinence. Women in our study reported making several lifestyle modifications to accommodate their urinary incontinence symptoms that speak to the impact of urinary incontinence on daily life. The impact of urinary incontinence on emotional well-being

further reinforces the need to identify modifiable risk factors and to aim for prevention.

We provide evidence that fetal macrosomia is associated strongly with anal sphincter lacerations. These findings are consistent with previous data, which suggested that the increased mechanical stress of a larger infant causes greater damage to the pelvic floor.^{6,21,22} In addition, our evidence suggests that both forceps- (OR, 4.75) and vacuum- (OR, 3.51) assisted deliveries have strong associations with anal sphincter laceration.

Our results regarding episiotomy type support previous reports that suggested a protective effect of mediolateral episiotomy and an increased risk of sphincter laceration that were associated with midline episiotomy.^{13,23} These results differ from the findings of Handa et al,⁶ who found that episiotomy has a protective effect on the incidence of third-degree lacerations but an increase in fourth-degree lacerations. Although previous studies have cited up to a 9-fold increase in anal sphincter injury after midline episiotomy, our study found that midline episiotomies (OR, 2.24) were three times more likely than mediolateral episiotomies (OR, 0.66) to cause anal sphincter laceration.²⁴⁻²⁶ Poen et al¹⁶ retrospectively studied 702 women who were delivered vaginally. One hundred twenty of these women sustained third-degree lacerations. They found the protective OR was 0.6 for mediolateral episiotomy. Coats et al²³ found that 11.6% of midline episiotomies extended to third- or fourth-degree lacerations versus 2% of mediolateral episiotomies. In their study, total pain, the use of analgesics, and wound breakdown was similar between the two types of episiotomies. Patients who had midline incisions, however, began intercourse significantly earlier.

The protective effect of mediolateral episiotomies has not been shown clearly in randomized trials when restrictive or no episiotomy are compared with mediolateral episiotomies in Europe and Argentina.²⁷⁻²⁹ Whether the mediolateral episiotomy is protective is still a question; but unlike the midline episiotomy, it does not increase the incidence of sphincter lacerations. Our data reinforce the theory that an episiotomy should be avoided if possible; however, if needed, a mediolateral episiotomy is preferred for protection against anal sphincter lacerations.

In this study, anal sphincter laceration was common and highly associated with fecal incontinence. Five hundred six of the original 2858 women (17.7%) who were enrolled in the study and 165 of the 831 women (19.9%) who completed our bowel control survey sustained third- or fourth-degree lacerations during childbirth. This incidence is substantially higher than the 5.9% incidence of third- and fourth-degree lacerations that were reported previously by Handa et al⁶ and is probably the result of the higher use of midline episiotomies. Our population of patients was delivered at

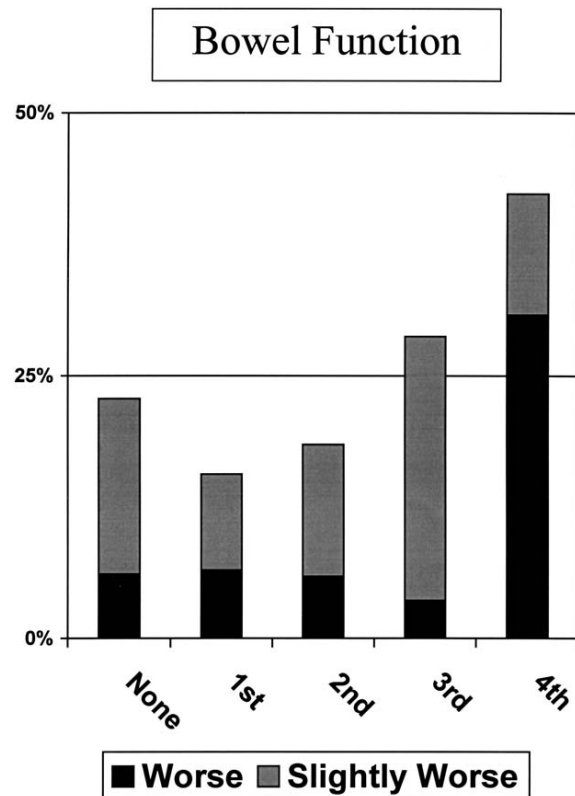


Figure. Bowel function.

a tertiary teaching hospital in the Midwest. Obstetric practices and modes of delivery differ greatly, depending on type of health care provider, geographic location, and patient population.²⁴ The incidence of third- and fourth-degree lacerations in any obstetric population will differ according to the incidence of risk factors, as reported in this study.

In response to the survey, greater than one fifth of the women (21.7%) reported slightly worse or worse bowel function after pregnancy. Women who had had anal sphincter lacerations had a higher incidence of fecal incontinence; 30.2% of the women had slightly worse or worse function compared with 19.7% of women without sphincter lacerations ($P < .01$). These findings are consistent with previous findings that established a relationship between sphincter trauma and incontinence.^{12,30,31} Similar to our study, despite immediate diagnosis and repair of anal sphincter lacerations, Zetterstrom et al⁷ found 41% of women with fecal and flatal incontinence at 9 months after a third- or fourth-degree laceration. Yet not all women who complained of worsening bowel control had third- or fourth-degree lacerations at the time of delivery. Whether these patients had occult lacerations as suggested by postpartum transanal ultrasound scans as seen by Sultan et al⁹ or had sustained a nerve injury during

vaginal delivery cannot be determined from this study. But these findings reinforce that anal incontinence after delivery is multifactorial and not all attributable to gross sphincter lacerations.

Although a strong association has been made between anal sphincter laceration and fecal incontinence, most studies have failed to distinguish between the separate risks of third- and fourth-degree lacerations.¹⁵ Our most striking finding was the nearly 10-fold increase in worse bowel control reported by women with fourth-degree lacerations (30.8%) compared with women with third-degree lacerations (3.6%). Sangalli et al³² contacted 208 women 13 years after vaginal delivery. A questionnaire assessed fecal incontinence and bowel function. They found that 25% of the women with fourth-degree lacerations compared with 11.5% of women with third-degree lacerations had a complaint of any anal incontinence, including loss of gas, liquid, or solid stool.

These findings have both clinical and possible pathophysiologic implications. The external anal sphincter forms the outer layer of the muscular tube surrounding the anal canal. The internal anal sphincter (IAS) is the inner, involuntary smooth muscle component that ranges 2.2 to 3.6 cm in length and extends >1 cm above the cranial margin of the external anal sphincter.^{33,34} The higher incidence of fecal incontinence that is associated with fourth-degree lacerations may imply the greater consequence of the loss of the IAS in bowel control. **The role of the IAS in the maintenance of anal continence is ambiguous.** Sultan et al⁹ found that women with IAS defects on transanal ultrasound scanning had symptoms of fecal urgency and anal incontinence after delivery. Yet, despite its significant contribution to resting anal canal pressures, the total division of the IAS in surgery for anal fistulas or fissures may fail to compromise continence in otherwise healthy subjects. More recent studies and improved diagnostic techniques have reported abnormalities of the IAS, in both structure and neuromuscular function, that correlate with anal incontinence.³⁵⁻³⁷ Unfortunately, surgical outcomes after IAS repairs have had mixed results.^{36,38} Many surgeons believe the IASs cannot hold sutures and that the suture pull-through results in the failure of the repair. This may indeed be the case with our patients as well, which resulted in the 10-fold increase in worse bowel control for women with IAS lacerations compared with those women with external anal sphincter lacerations only. Further analysis with imaging studies is required to determine whether it is the tear or "failed repair" that increases symptoms.

There are obvious limitations to our study. First, it was a retrospective study that asked women to recall bladder and bowel habits before delivery and then to compare those habits to their current control. Not all women completed the questionnaire, and women who have seen a negative change in their bowel and bladder control are

probably more likely to have completed the questionnaire than those who did not. In addition, impact of delivery was measured only by symptoms, and no objective testing was reported. However, we did evaluate not only the presence or absence of urinary or fecal incontinence symptoms but also the impact on the woman's life and change in normal activities. In a comparison of symptoms to obstetric events, complete obstetric data were found for all the women who returned the questionnaires.

In conclusion, similar risk factors for third- and fourth-degree lacerations were found in our population when compared with most studies that were performed in Europe, with the notable exception of the higher use of midline episiotomies in our study. Midline episiotomy independently increased the incidence of gross sphincter laceration, and sphincter laceration was found to be associated with fecal incontinence. Fourth-degree lacerations had a worsening impact on bowel control compared with third-degree lacerations.

REFERENCES

- Farrell SA, Allen VM, Baskett TF. Parturition and urinary incontinence in primiparas. *Obstet Gynecol* 2001;97:350-6.
- Zetterstrom JP, Lopez A, Anzen B, Dolk A, Norman M, Mellgran A. Anal incontinence after vaginal delivery: a prospective study in primiparous women. *BJOG* 1999;106:324-30.
- Hunskar S. Epidemiology and natural history of urinary incontinence. *Int Urogynecol J* 2000;11:301-19.
- Mant J. Epidemiology of genital prolapse: observations from the Oxford Family Planning Association Study. *BJOG* 1997;104:579-85.
- Ryhammer AM, et al. Multiple vaginal deliveries increase the risk of permanent incontinence of flatus and urine in normal premenopausal women. *Dis Colon Rectum* 1995;38:1206-9.
- Handa VL, Danielsen BH, Gilbert WM. Obstetric anal sphincter lacerations. *Am Coll Obstet Gynecol* 2001;98:225-30.
- Zetterstrom J, Lopez A, Anzen B, Norman M, Holstrom B, Mellgren A. Anal sphincter tears at vaginal delivery: risk factors and clinical outcome of primary repair. *Obstet Gynecol* 1999;94:21-8.
- Zetterstrom J, Lopez A, Anzen B, et al. Anal sphincter tears at vaginal delivery: risk factors and clinical outcome of primary repair. *Obstet Gynecol* 1999;94:21-8.
- Sultan AH, Kamm MA, Hudson CN, Thomas JM, Bartram CI. Anal sphincter disruption during vaginal delivery. *N Engl J Med* 1993;329:1905-11.
- Sultan AH, Kamm MA, Hudson CN, Bartram CI. Third degree obstetric anal sphincter tears: risk factors and outcome of primary repair. *BMJ* 1994;308:887-91.
- Haadem K, Gudmundsson S. Can women with intrapartum rupture of anal sphincter still suffer after-effects two decades later? *Acta Obstet Gynaecol Scand* 1997;76:601-3.
- Zetterstrom JP, Lopez A, Anzen B, Dolk A, Norman M, Mellgran A. Anal incontinence after vaginal delivery: a prospective study in primiparous women. *BJOG* 1999;106:324-30.
- deLeeuw JW, Struijk PC, Vierhout ME, Wallenburg HCS. Risk factors for third degree perineal ruptures during delivery. *BJOG* 2001;108:383-7.
- DeLancey JOL. Childbirth, continence, and the pelvic floor. *N Engl J Med* 1993;329:1956-7.
- Nygaard IE, Rao SSC, Dawson JD. Anal incontinence after anal sphincter disruption: a 30-year retrospective cohort study. *Obstet Gynecol* 1997;89:896-901.
- Poen AC, Felt-Bersma RJF, Dekker GA, Deville W, Cuesta MA, Meuwissen SGM. Third degree obstetric perineal tears: risk factors and the preventive role of mediolateral episiotomy. *BJOG* 1997;104:563-6.

17. Crawford LA, Quint EH, Pearl ML, Delancey JO. Incontinence following rupture of the anal sphincter during delivery. *Obstet Gynecol* 1993;82:527-31.
18. Tetzschner T, Sorenson M, Lose G, Christiansen J. Anal and urinary incontinence in women with obstetric anal sphincter rupture. *BJOG* 1996;103:1034-40.
19. Zetterstrom J, Mellgren A, Jensen LL, Wong WD, Kim DG, Lowry AC, et al. Effect of delivery on anal sphincter morphology and function. *Dis Colon Rectum* 1999;42:1253-60.
20. Viktrup L, Lose G, Rolff M, Barfoed K. The symptom of stress incontinence caused by pregnancy or delivery in primiparas. *Obstet Gynecol* 1992;79:945-9.
21. Peleg D, Kennedy CM, Merrill DE, Zlatnik FJ. Risk of repetition of a severe perineal laceration. *Obstet Gynecol* 1999;93:1021-4.
22. Robinson JN, Norwitz ER, Cohen AP, McElrath TF, Lieberman ES. Epidural analgesia and third- or fourth-degree lacerations in nulliparas. *Obstet Gynecol* 1999;94:259-62.
23. Coats PM, Chan KK, Wilkins M, Beard RJ. A comparison between midline and mediolateral episiotomies. *BJOG* 1980;87:408-12.
24. Green JR, Soohoo SL. Factors associated with rectal injury in spontaneous deliveries. *Obstet Gynecol* 1989;73:732-8.
25. Combs CA, Robertson PA, Laros RK. Risk factors for third-degree and fourth-degree perineal lacerations in forceps and vacuum deliveries. *Am J Obstet Gynecol* 1990;163:100-4.
26. Shiono P, Klebanoff MA, Carey JC. Midline episiotomies: More harm than good? *Obstet Gynecol* 1990;75:765-70.
27. Harrison RF, Brennan M, North PM, Reed JV, Wickham EA. Is routine episiotomy necessary? *BMJ* 1984;288:1971-5.
28. Sleep J, Grant A, Grant A, Garcia J, Elbourne D, Spencer JA. West Berkshire perineal management trial. *BMJ Clin Res Ed* 1984;289:587-90.
29. Argentine Episiotomy Trial Collaborative Group. Routine vs selective episiotomy: a randomized controlled trial. *Lancet* 1993;42:1517-8.
30. Chaliha C, Sultan AH, Bland JM, Monga AK, Stanton SL. Anal function: effect of pregnancy and delivery. *Am J Obstet Gynecol* 2001;185:427-32.
31. Abramowitz L, Sobhani I, Ganasia R, et al. Are sphincter defects the cause of anal incontinence after vaginal delivery? Results of a prospective study. *Dis Colon Rectum* 2000;43:590-6.
32. Sangalli MR, Floris L, Faltin D, Weil A. Anal incontinence in women with third or fourth degree perineal tears and subsequent vaginal deliveries. *Aust N Z J Obstet Gynaecol* 2000;40:244-8.
33. Fenner DE, Kriegshauser JS, Lee HH, Beart RW, Weaver A, Cornella JL. Anatomic and physiologic measurements of the internal and external anal sphincters in normal females. *Obstet Gynecol* 1998;91:369-74.
34. Delancey JOL, Toglia MR, Perucchini D. Internal and external anal sphincter anatomy as it relates to midline obstetric lacerations. *Obstet Gynecol* 1997;90:924-7.
35. Sangwan YP, Solla JA. Internal anal sphincter: advances and insights. *Dis Colon Rectum* 1998;41:1297-311.
36. Abou-Zeid AA. Preliminary experience in management of fecal incontinence caused by internal anal sphincter injury. *Dis Colon Rectum* 2000;43:198-204.
37. Garcia-Aguillar J, Belmonte C, Wong WD, Lowry AC, Madoff RD. Open vs closed sphincterotomy for chronic anal fissure: long term results. *Dis Colon Rectum* 1996;39:440-3.
38. Leroi AM, Kamm MA, Weber J, Denis P, Hawley PR. Internal anal sphincter repair. *Int J Colorectal Dis* 1997;12:243-5.

Discussion

DR REBECCA ROGERS, Albuquerque, NM. This was an interesting study that evaluated the sequelae of vaginal birth in primiparous women who underwent vaginal delivery in an American obstetrical unit. The authors performed a chart review of 2941 primiparous women who were delivered vaginally at the University of Michigan

and attempted to contact them 6 months after the delivery to fill out questionnaires that evaluated bowel and bladder function. The authors concluded that women with fourth-degree lacerations are more likely to have fecal incontinence than women with third-degree lacerations. The subject is of importance in the practice of obstetrics and gynecology and offers some prospective data regarding the impact of vaginal delivery on pelvic floor function.

How do you think the poor response rate for the women who were surveyed influenced your conclusions? For example, 33% of the women answered the urinary incontinence questionnaire; 29% of the women answered the bowel function questionnaire; and of women who were surveyed, only 165 of 506 women (33%) had sustained third- or fourth-degree lacerations. This led to a final comparison of 6 women with fourth-degree lacerations and 27 women with third-degree lacerations, with the final conclusion that women with fourth-degree lacerations were 10 times more likely to complain of worse bowel function than women with third-degree lacerations.

What was the breakdown of high- and low-risk pregnancies in this population? If this represents a high-risk population, the information might not be generalizable to women with low-risk pregnancies.

Why did the authors not use any of the validated and reliable questionnaires that are available in the literature? The use of nonvalidated instruments will limit the interpretability of your results.

The authors stated that worse bowel control was seen with women with fourth-degree lacerations because the IAS was always disrupted in women with fourth-degree lacerations. Is it possible for a patient to have a third-degree laceration that extends through the IAS and a fourth-degree laceration that does not? Was there any attempt at the time of delivery to try to document which of the anal sphincters was disrupted?

DR FENNER (Closing). First, as I said, there were limitations with the response rates. But if you did look at the entire population versus the women who responded, the groups are virtually the same in terms of the type of laceration. Obviously though, you would think that, in terms of bias, if someone had symptoms, that person may be more likely to report those symptoms. So, yes, we do recognize that is a limitation.

In terms of the future, obviously this is just a springboard. There is really only one other study from Australia that looked at 206 women in which they were able to separate third- and fourth-degree lacerations. They found approximately a three-times-higher chance of symptoms 12 years after delivery in women who had sustained a fourth-degree versus a third-degree laceration. But that is the only report that we were able to separate third- and fourth-degree lacerations. I really do think it is the IAS that is the problem here.

In terms of separating high- and low-risk patients, these were all vaginal deliveries of primiparous women. We do have a fairly large community-based group of physicians