

Obstetric sphincter tears and anal incontinence: an observational follow-up study

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Background. Persistent defects after primary sphincter repair and occult sphincter tears are common after vaginal deliveries. Anal incontinence may be associated with these morphological defects.

Material and methods. Forty-six primiparous women were evaluated with ultrasonography, manometry and electrophysiology. Twenty-four women had undergone primary repair of obstetric sphincter tears (sphincter group), 16 women had no clinical sphincter tear but developed anal incontinence postpartum (symptom group), and six were delivered by elective cesarean section (cesarean group).

Results. In the sphincter group, 50% had anal incontinence at follow-up. At ultrasonography, 70% had injuries anteriorly in the midanal canal. At manometry, 4% had decreased resting pressure and 50% decreased squeeze pressure. At electrophysiology, 19% had pathologic pudendal latency and 25% pathologic fiber density.

In the symptom group, 44% had injuries anteriorly in the midanal canal at ultrasonography. At manometry, all women had normal resting pressure and 19% had a decreased squeeze pressure. At electrophysiology, 46% had pathologic pudendal latency and 29% pathologic fiber density.

In the cesarean group, 33% had mild anal incontinence at follow-up. Ultrasonography and manometry were normal in all women. At electrophysiology, 33% had pathologic pudendal latency and 17% pathologic fiber density.

Conclusion. Anal sphincter injuries at childbirth are often inadequately diagnosed and primary repair frequently results in persisting defects in the anal sphincter. Anatomic injuries to the anal sphincter play an important role in the development of anal incontinence after delivery, but a significant proportion of symptomatic women also demonstrate neurologic impairment at electrophysiologic testing.

Key words: sphincter tear; perineal laceration; anal incontinence; vaginal delivery; childbirth

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Abbreviations:

E AUS: endoanal ultrasonography; EAS: external anal sphincter muscle; EMG: electromyography; IAS: internal anal sphincter muscle; PR: puborectal muscle; MRP: mean maximum resting anal canal pressure; MSP: mean maximum voluntary anal canal pressure; HPZ: high pressure zone; PNTML: pudendal nerve terminal motor latency; FD: fiber density.

Perineal lacerations are a common complication at childbirth. The majority of these are first- or second-degree tears with no or minimal clinical sequel; however, these lacerations are poorly studied. More severe injuries involve the anal sphincter and are usually classified as third- and fourth-degree tears. These are less common, and the incidence is usually approximately 3% in

vaginal deliveries (1–4). These deeper tears are primarily repaired, but about 40% of affected women develop anal incontinence and sphincter tears are thus a serious obstetric complication (4–6).

Diagnosis and repair of sphincter tears at delivery are important, but they are nevertheless frequently clinically undetected. In 1993, a British study (7) reported a high incidence of occult sphincter injuries at delivery and a significant association with anal incontinence.

Since endoanal ultrasonography (EAUS) was introduced about 15 years ago, it has become the most important method in assessing sphincter defects. However, some women suffer from anal incontinence without any sphincter injury at EAUS (8,9). A possible pathogenesis in these women may be injuries to the innervation in the anal sphincter, which may be verified electrophysiologically (10).

The aims of the present study were to evaluate 1) primiparous women who had sustained a clinical sphincter tear at delivery and 2) primiparous women who had developed anal incontinence after delivery without sustaining a clinical sphincter tear. Both groups were compared with a control group of women delivered by elective cesarean section.

Materials and methods

In a previous study (11), all Swedish-speaking primiparous women delivered during a 10-week period in 1995 at Danderyd Hospital were asked to participate in a prospective consecutive questionnaire study regarding anal incontinence that could be correlated to childbirth. Anal

incontinence was defined as involuntary leakage to flatus or solid stool. The degree of incontinence was defined as no symptoms, symptoms less than once a week, more than once a week or symptoms every day. Only Swedish-speaking women with no preexisting symptoms were included in the original study. During the study period, 422 primiparous women were delivered, 352 vaginally and 70 by cesarean section. A questionnaire regarding anal incontinence before the pregnancy was distributed during the first days after delivery. A second and a third questionnaire were distributed by mail at 5 and 9 months after delivery. In total, 278 women responded to all three questionnaires and were included.

From this population, three groups of primiparous women were selected and evaluated in a follow-up study including EAUS, anorectal manometry and electrophysiologic evaluation. The first group (sphincter group) consisted of women who had sustained a clinical anal sphincter tear at delivery. Twenty-four of 39 women agreed to participate (Table I). At the clinical evaluation in connection to the delivery, two women had sustained a fourth-degree tear involving the sphincter and the anorectal mucosa, three had sustained a complete third-degree tear involving the complete depth and length of the anal sphincter, and 19 had sustained a partial tear involving some part of, but not the whole of, the anal sphincter. A second group (symptom group) consisted of women who developed anal incontinence without having any diagnosed sphincter tear at the delivery. Sixteen of 40 women agreed to participate in the follow-up study (Table I). Six of 22 women who

Table I. Characteristics of populations

	Tear group		Symptom group		Cesarean group	
	Participants (n=24)	Nonparticipants (n=14)	Participants (n=16)	Nonparticipants (n=27)	Participants (n=6)	Nonparticipants (n=16)
Age	30 ± 3	31 ± 4	32 ± 5	31 ± 4	35 ± 5	31 ± 6
Nullipara	24	14	16	27	6	16
Gestational age (days)	285 ± 8	290 ± 2	284 ± 7	282 ± 10	260 ± 25	266 ± 24
Second stage of labor (h)	1.5 ± 1.1	1.8 ± 1.8	1.1 ± 0.8	1.6 ± 1.3		
Fetal weight (g)	3686 ± 391	3627 ± 422	3630 ± 382	3536 ± 474	2621 ± 909	3062 ± 909
Delivery posture						
Upright	8	6	9	15		
Nonupright	16	8	7	12		
Interventions during labor						
Forceps	0	0	0	0		
Vacuum extraction	5	4	2	3		
Fundal pressure	15	6	4	8		
Episiotomy	2	1	1	0		
Obstetrical tears						
No tear or first degree	0	0	5	12		
Second degree	0	0	11	15		
Third degree	22	14	0	0		
Fourth degree	2	0	0	0		

were delivered by elective cesarean section (cesarean group) agreed to participate (Table I). The evaluation was carried out in mean 73 ± 19 weeks after the delivery.

All women in the present study were healthy females and had no history of bowel disease, neurologic disease or diabetes mellitus.

Perineal tears

Deliveries were managed according to Swedish obstetric routines in which most uncomplicated deliveries are handled by midwives. Obstetricians were called upon when necessary to assess complicated deliveries or to perform instrumental or cesarean deliveries. There was always at least one staff obstetrician and one resident on call at the ward.

Perineal tears were classified into four degrees according to the international classification of diseases (12). A first-degree tear involved the forchet, the perineal skin and vaginal epithelium but not the underlying fascia and muscles. A second-degree tear also involved the fascia, muscles and perineal body but not the anal sphincter. A third-degree tear involved the anal sphincter but does not extend through the anorectal mucosa. A fourth-degree tear was defined as extending through the rectal mucosa. Diagnosis of perineal tears was made by the attending midwife. When a sphincter tear was suspected, the obstetrician was called upon and the diagnosis of a sphincter injury was verified by physical examination. All sphincter tears were repaired primarily by the attending obstetrician using the technique of end-to-end approximation of the ruptured muscle. The operation charts from these interventions were reviewed retrospectively.

Questionnaire

The questionnaires included previous medical history and symptoms of gas and fecal incontinence based on Miller et al. (13). Regarding incontinence symptoms, subjects were asked two questions: 1) Do you experience incontinence to flatus, i.e. do you have involuntary leakage of intestinal gas? and 2) Do you experience incontinence to fecal contents, i.e. do you have involuntary leakage of stools? The subjects had four alternative answers to each of these questions: 1) No; 2) Yes, less than once a week; 3) Yes, more than once a week; and 4) Yes, daily.

Endoanal ultrasonography

EAUS was performed using an ultrasound scanner (Panter 2002, B&K Medical Sandtoften,

Denmark), with a 1850 rotating endosonic probe providing a 360° image. A 10-MHz 6004 transducer was used.

All sonographies were performed by one examiner (Å.T.) who was blinded regarding the clinical situation.

The endosonographic criterion for diagnosis of anal sphincter injury, that is a discontinuity in the muscle ring, was the detection of a distinct change in ultrasonographic appearance from the remaining anal sphincter ring at the distal, mid and upper anal canal.

Anorectal manometry

Manometry was performed using a flexible, polyethylene, water-perfused catheter with a radial head design (Arndorfer, Inc., Greenvale, WI, USA) connected to a hydraulic microcapillary perfusion pump (Arndorfer, Inc.). Water was infused through six channels at a constant rate of 0.5 mL/min. The water perfusion apparatus was connected to manometry hardware (Synectics, Inc., Irving, TX, USA) interfaced with a PC on which data were presented and stored.

The stationary pull-through technique was used. The catheter was introduced into the rectum and the pressures were measured at 1-cm intervals, starting at 6 cm above the anal verge.

Mean maximum resting anal canal pressure (MRP), mean maximum voluntary squeeze anal canal pressure (MSP) and the length of the high pressure zone (HPZ) were measured. Normal MRP and normal MSP were both defined as 40–80 mmHg. The normal length of the HPZ was defined as >20 mm.

Electrophysiology

The external anal sphincter is bilaterally innervated by the pudendal nerve. Injury to these nerves at delivery, by compression or stretching, may impair the function of the muscle.

Electrophysiologic assessment consisted of measurement of pudendal nerve terminal motor latency (PNTML) bilaterally and fiber density (FD).

PNTML was measured using the technique described by Swash and Snooks (14). The examinations were performed with the women in the right lateral position and the left and right sides of the external anal sphincter were analyzed separately. Normal PNTML was defined as <2.2 ms.

Electromyography (EMG) assessments were performed with a Nihon Kohden Neuropack 2

electromyograph (Nihon Kohden Corp., Tokyo, Japan). Reusable needle electrodes (Nicolet 019-730900, Nicolet Biomedical Inc, Madison, WI, USA) for single-fiber EMG were used. Fiber density (FD) measurement by single-fiber EMG in the external anal sphincter was performed by a skin insertion at the anal verge. FD was measured by recordings at 20 different locations on the left side of the external anal sphincter muscle (EAS).

FD increases with age and upper normal limits are therefore adjusted to the age of the women. Upper normal values (mean + 2SD) were considered to be 1.52 under the age of 30 and 1.82 over the age of 30 (15–17).

Ethical approval

The study was approved by the Local Ethics Committee at Karolinska Hospital, Karolinska Institutet, Stockholm. All subjects gave their informed consent to participate.

Results

Sphincter group

Based on the assumption that the clinical diagnosis of sphincter injury is difficult (7) and that the extension of tears are often underestimated, we chose to analyze all sphincter tears as a group. Fifty percent (12/24) of the women in the sphincter group had various degrees of incontinence for gas (Table II). At EAUS in the upper anal canal, no woman in the sphincter group had a visible injury in the puborectalis muscle. In the midanal canal, 70% (16/23) had anterior anal sphincters injuries. Twenty-six percent (6/23) had involvement of only the EAS, 4% (1/23) of only the internal anal sphincter muscle (IAS) and

Table II. Anal incontinence at 9 months after delivery in the different groups

Severity and degree of incontinence	Group		
	Tear (n = 24)	Symptom (n = 16)	Cesarean (n = 6)
No symptoms	12	0	4
Fecal incontinence			
<1/week	0	2*	0
>1/week	0	0	0
Daily	0	0	0
Gas incontinence			
<1/week	8	11	1
>1/week	4	2	1
Daily	0	1	0

Each individual woman is only included once in the table. *One of the women in the symptom group suffered from both fecal incontinence and gas incontinence and she was thus not included in the gas incontinence frequency.

39% (9/23) of both sphincters (Table III). In the distal anal canal, 10% (2/23) of the women had injuries in the EAS. Both these women had sustained a partial sphincter tear at delivery and EAUS revealed a combined injury to EAS and IAS in the midanal canal, and the injury in the distal EAS was continuous with the injury in the midanal canal.

Of women with extensive tears at delivery (a fourth- or complete third-degree tear at delivery; n = 5), four had injuries at EAUS in both the EAS and IAS but none had a visible injury in the distal EAS. One woman declined evaluation with EAUS.

At manometry, the mean MRP and mean MSP were within defined normal values in the sphincter group (Table IV). Four percent (1/24) had an MRP lower than normal and 50% (12/24) had an MSP lower than normal. The mean length of the HPZ was normal and the length of the HPZ was less than 20 mm in 12% (3/24) of the women (Table IV).

At electrophysiologic assessment, the mean PNTML was normal on both the left and right sides (Table V). Thirteen percent (2/16) had pathologic PNTML unilaterally and additionally 6% (1/16) bilaterally. Mean FD was normal (Table V) and FD was pathologic in 25% (4/16) of the women in the sphincter group.

Symptom group

All women in the symptom group had anal incontinence, as it was an inclusion criterion for this group in the present study (Table II).

At EAUS in the upper anal canal, no woman had a visible injury in the puborectalis muscle (PR). In the midanal canal, 44% (7/16) had injuries anteriorly in the anal sphincters. Twenty-five percent (4/16) had involvement of only the EAS, 6% (1/16) of only the IAS and 13% (2/16) of both sphincters (Table III). None of the women had injuries in the distal EAS.

At manometry, the mean MRP and mean MSP were within defined normal values in the

Table III. Endoanal ultrasonography in midanal canal

Location of injury	Group		
	Tear (n = 23)	Symptom (n = 16)	Cesarean (n = 6)
EAS, exclusively (% , n)	26 (6)	25 (4)	0 (0)
IAS, exclusively (% , n)	4 (1)	6 (1)	0 (0)
EAS and IAS (% , n)	39 (9)	13 (2)	0 (0)
No visible injury (% , n)	30 (7)	56 (9)	100 (6)

EAS, external anal sphincter; IAS, internal anal sphincter.

Table IV. Anorectal manometry at follow-up

	Group		
	Tear (n = 24)	Symptom (n = 16)	Cesarean (n = 6)
MRP (mmHg) (mean ± SD)	59 ± 13	75 ± 14	70 ± 16
MSP (mmHg) (mean ± SD)	44 ± 23	63 ± 27	100 ± 42
Length of HPZ (mm) (mean ± SD)	27 ± 6	26 ± 6	24 ± 3

MRP, mean maximum resting pressure; MSP, mean maximum voluntary squeeze pressure; HPZ, high pressure zone.

symptom group (Table IV). All women had normal MRP. Nineteen percent (3/16) had an MSP lower than normal. The mean length of the HPZ was normal and the length of the HPZ was less than 20 mm in 13% (2/16) of the women (Table IV).

At electrophysiologic assessment, the mean PNTML was normal on both the left and right side in all women (Table V). Twenty-one percent (3/14) had pathologic PNTML unilaterally and additionally 21% (3/14) bilaterally. Mean FD was normal (Table V) and FD was pathologic in 29% (4/14) of the women in the symptom group.

Cesarean group

Thirty-three percent (2/6) of the women in the cesarean group had various degrees of gas incontinence (Table II).

All women in the cesarean group had normal sphincters at EAUS and normal pressures and HPZ at manometry (Tables III and IV). Seventeen percent (1/6) had pathologic PNTML unilaterally and an additional 17% (1/6) bilaterally. Seventeen percent (1/6) had pathologic FD (Table V).

Discussion

The present study demonstrates that a significant number (83%) of women sustaining a clinical sphincter tear at delivery and/or developing symptoms of anal incontinence after delivery have abnormalities at follow-up with EAUS,

anorectal manometry and electrophysiology. These findings agree with previously reported findings by Sultan et al. (7) and emphasizes the importance of evaluating women with persistent anal incontinence after delivery.

Fifty percent of the women with a repaired sphincter injury at the time of delivery had symptoms of mild anal incontinence at follow-up 9 months postpartum, which is in accordance with several previous reports (4,5,18,19). Thus, a clinical sphincter tear at delivery is a serious obstetric complication.

Seventy percent of women who had undergone primary sphincter repair (sphincter group) had ultrasonographic injuries at EAUS. This finding, in combination with the high frequency of symptoms in this group of women, indicates that persisting sphincter defects play an important role in the symptomatology after primary repair of the sphincters. Women who had undergone an elective cesarean section had no sphincter defects at EAUS (Table III).

In the present study tears were managed in the traditional way, that is primary repair with end-to-end anastomosis, immediately in the delivery unit by the obstetrician on call. Other authors have favored a different approach. Sultan et al. (20) have reported an improved outcome using an overlapping technique at primary repair, but their population was fairly small. In two more recent and larger studies (21,22), the result of the overlap technique was not superior to the end-to-end approximation. There are no previous studies comparing the outcome of sphincter repair under the operative conditions used in the present study and primary repair under "optimal" conditions in the operation room by specialized obstetricians/colon and rectal surgeons. Our results indicate that studies evaluating these aspects could be of importance.

All women with severe tears (total third- or fourth-degree tears) had injuries to both the IAS and EAS at midlevel in the anal canal at EAUS, but no extensions to the distal part of EAS. This finding may imply that the repair is carried out more efficiently in the distal part of the injury compared to the proximal part.

In the present study, the majority of injuries involved the EAS whereas isolated injuries in the IAS were rare. This is in contrast to the findings of Sultan et al. (7), who reported that the injuries were more frequent in the IAS. The reason for this difference is difficult to explain, as the IAS is well visualized at EAUS whereas the delineation of anterior injuries in the EAS is sometimes difficult.

Table V. Electrophysiology at follow-up

	Group		
	Tear (n = 16)	Symptom (n = 13)	Cesarean (n = 6)
PNTML sin (ms) (mean ± SD)	2.0 ± 0.4	2.1 ± 0.4	2.1 ± 0.4
PNTML dx (ms) (mean ± SD)	1.9 ± 0.4	2.0 ± 0.3	2.0 ± 0.3
FD (mean ± SD)	1.6 ± 0.2	1.6 ± 0.1	1.5 ± 0.1

PNTML, pudendal nerve terminal motor latency; FD, fiber density, performed at "3 o'clock".

Several studies have indicated that EAUS is a reliable method for assessing sphincter defects (23–25), but a recent study (26) demonstrated that sphincter injuries may sometimes be overestimated at EAUS. Expertise in the EAUS technique is of utmost importance when assessing potential sphincter injuries. In the present study all evaluations were performed by one experienced ultrasonographer (Å.T.).

At manometry, half the women in the sphincter group had pathologic MSP while MRP was decreased in only 4% of the women. This finding correlates well with the sphincter injuries found at EAUS; the majority of injuries were found in the EAS. This correlation between the function of the external sphincter and the squeeze pressure has been reported previously (27,28). Sultan et al. (7) also reported that the MSP was more affected than the MRP after sphincter injuries.

Relatively few women with a sphincter tear had pathologic PNTML (19%). In previous studies no prolonged PNTML in association with episiotomy or perineal tears was seen (10,29). Our results indicate that some women sustain both an anatomic injury to the anal sphincter and a concomitant injury to the innervation of the anal sphincter. This finding is difficult to evaluate, as the relevance of the PNTML is debated. A nerve injury shown as a prolonged pudendal latency may result in anal incontinence later in life (29). Some authors claim that pathologic PNTML is an adverse indicator for postoperative outcome after sphincter repair (30,31), whereas other authors have not been able to confirm this (32,33).

In the group of women who suffered from anal incontinence, but without a sphincter tear on clinical examination at delivery, 43% had a sphincter injury at EAUS. These injuries were located anteriorly and mostly in the EAS (Table IV). This finding demonstrates that a significant number of sphincter tears were not diagnosed at clinical examination at the time of delivery, which is in accordance with previously reported results (7,34). An accurate examination with bidigital technique in order to correctly identify the extent of the injury at the time of delivery is of utmost importance. This study, together with some previous studies (7), indicates that women with persisting anal incontinence after delivery should be recommended further evaluation with EAUS, in order to clarify the underlying pathogenesis for their symptoms.

Some women had more extensive injuries in the proximal part of the sphincter muscles than in the distal part. Women immediately postpartum are not always accessible to thorough examination

because of discomfort and pain, making diagnosis of these injuries difficult. This finding demonstrates the importance of carrying out a careful bidigital examination of the anterior part of the anal sphincter with the index finger in the anal canal and the thumb in the wound. Knowledge of the anatomy of the pelvic floor, as well as of the operative technique, is also fundamental (35).

The present study raises the question of whether sphincter injuries should be screened by EAUS in the delivery unit. Faltin et al. (36) have recently demonstrated that 28% of nulliparous women with no clinical sphincter injury had a tear at EAUS immediately after delivery. A prospective study with EAUS performed in late pregnancy, immediately after delivery and at a later follow-up, may be of interest.

Relatively few of the women in the symptom group had decreased pressures on manometry. This result may be explained by the fact that the majority of these women had mild symptoms (Table III). Our findings indicate that manometry is frequently inconclusive in subjects with mild symptoms of anal incontinence, which is in accordance with previous reports (37).

Several women (46%) in the symptom group had pathologic findings on electrophysiologic evaluation 18 months postpartum. A previous study has reported prolonged pudendal latencies after childbirth in 33% of primiparous women shortly after delivery, but that these values had usually normalized within 2 months (10). Our findings could support a relationship between neurologic impairment and anal incontinence.

At 9 months after cesarean delivery two out of six women had symptoms of anal incontinence. All women in the cesarean group had normal findings on EAUS and manometry, which is in accordance with findings of Sultan et al. (38). The pelvic floor and the anal sphincter are not exposed to any of the forces experienced during a vaginal delivery and injuries to the anal sphincter would thus not be expected. Tetzschner et al. (39) have previously reported on the effect of pregnancy on PNTML and did not find any changes when performing repeated measurements throughout the pregnancy. Fynes et al. (40) reported prolonged PNTML after cesarean section late in labor, but no such affection among women following an elective cesarean section or a cesarean performed early in labor. All our cesarean sections were elective. The cesarean group in our study is too small to draw any further conclusions.

Most of the reported symptoms of anal incontinence were infrequent and of mild degree, but all symptoms were newly developed and related

to the delivery. Even if the present study has a limited number of participants, our findings may help to explain the underlying mechanisms for these symptoms. Anal incontinence frequently results in psychologic and social suffering and affected individuals may be so embarrassed that they do not spontaneously bring up the subject when seeking medical advice (41). Hence, it is of utmost importance to be aware of the risk of anal incontinence following delivery and therefore explicitly inquire about anal incontinence at follow-up.

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