Received: 3 August 2023 | Revised: 13 November 2023 | Accepted: 20 November 2023

DOI: 10.1111/aogs.14742

ORIGINAL RESEARCH ARTICLE

Prevention of obstetric anal sphincter injuries with perineal support and lateral episiotomy: A historical cohort study

Torbjørn M. Eggebø[1,2] | Astrid Betten Rygh[2] | Phillip von Brandis[2] | Finn Egil Skjeldestad[3]

[1]Department of Clinical and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway

[2]Department of Obstetrics and Gynecology, Stavanger University Hospital, Stavanger, Norway

[3]Research Group Epidemiology of Chronic Diseases, Institute of Community Medicine, UiT the Arctic University of Norway, Tromsø, Norway

Correspondence
Torbjørn M. Eggebø, Department of Clinical and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway.
Email: torbjorn.eggebo@ntnu.no

Abstract

Introduction: There are many risk factors for obstetric anal sphincter injury (OASIS) and the interaction between these risk factors is complex and understudied. The many observational studies that have shown a reduction of OASIS rates after implementation of perineal support have short follow-up time. We aimed to study the effect of integration of active perineal support and lateral episiotomy on OASIS rates over a 15-year period and to study interactions between risk factors known before delivery.

Material and methods: We performed a historical cohort study over the periods 1999–2006 and 2007–2021 at Stavanger University Hospital, Norway. The main outcome was OASIS rates. Women without a previous cesarean section and a live singleton fetus in cephalic presentation at term were eligible. The department implemented in 2007 the Finnish concept of active perineal protection, which includes support of perineum, control of fetal expulsion, good communication with the mother and observation of perineal stretching. The practice of mediolateral episiotomy was replaced with lateral episiotomy when indicated. We analyzed the OASIS rates in groups with and without episiotomy stratified for delivery mode, fetal position at delivery and for parity, and adjusted for possible confounders (maternal age, gestational age, oxytocin augmentation and epidural analgesia).

Results: We observed a long-lasting reduction in OASIS rates from 4.9% to 1.9% and an increase in episiotomy rates from 14.4% to 21.8%. Lateral episiotomy was associated with lower OASIS rates in nulliparous women with instrumental vaginal deliveries and occiput anterior (OA) position; 3.4% vs 10.1% (OR 0.31; 95% CI: 0.24–0.40) and 6.1 vs 13.9% (OR 0.40; 95% CI: 0.19–0.82) in women with occiput posterior (OP) position. Lateral episiotomy was also associated with lower OASIS rates in nulliparous women with spontaneous deliveries and OA position; 2.1% vs 3.2% (OR 0.62; 95% CI: 0.49–0.80). The possible confounders had little confounding effects on the risk of OASIS in groups with and without episiotomy.

Abbreviations: OA, occiput anterior; OASIS, obstetric anal sphincter injuries; OP, occiput posterior; TGCS, ten group classification system.

Conclusions: We observed a long-lasting reduction in OASIS rates after implementation of preventive procedures. Lateral episiotomy was associated with lower OASIS rates in nulliparous women with an instrumental delivery. Special attention should be paid to deliveries with persistent OP position.

KEYWORDS
delivery mode, episiotomy, fetal position, OASIS, parity

1 | INTRODUCTION

Obstetric anal sphincter injury (OASIS) is a common complication to vaginal births. Immediate diagnosis and correct suturing is essential; however, preventing OASIS is even more important.[1,2] Parity, maternal age, gestational age, epidural analgesia, oxytocin augmentation, occiput posterior (OP) position, instrumental vaginal deliveries, the use of episiotomy and birthweight are factors known to be associated with OASIS.[3–7]

The incidence of OASIS was less than 1% in Norway in 1967 but increased to 3%–4% in the early 2000s, similar to incidences in Denmark and Sweden.[8] However, in Finland active perineal support was an established concept during vaginal delivery and the incidence remained less than 1%.[8] The Norwegian Directory of Health did in 2004 an audit of the labor ward at Stavanger University Hospital and remarked an unacceptably high OASIS rate of more than 5% for singleton, term, cephalic vaginal births. In 2006 the Directory launched a national action plan aimed to reduce sphincter injuries, and recommended implementation of the Finnish concept of manual perineal protection and the use of a lateral episiotomy when indicated. The intervention program was implemented in five other Norwegian hospitals, and a significant decrease in OASIS was reported.[9–12] In 2007, the labor ward at Stavanger University Hospital invited an obstetrician and a midwife from Finland to teach the preventing procedures and a hands-on training of all obstetricians and midwives was started.

The indications for episiotomy are discussed.[13–21] The recent Labor Care Guide from the World Health Organization states that routine or liberal use of episiotomy is not recommended for women undergoing spontaneous vaginal birth.[22] Primiparity and OP position are important risk factors for OASIS during instrumental vaginal delivery,[23] and episiotomy has been recommended in nulliparous women with an instrumental vaginal delivery.[24] The known risk factors interact, and more precise knowledge about the techniques and clinical indications for using episiotomy is desirable.[25] We aimed to study the effect of integration of active perineal support and lateral episiotomy on OASIS rates over a 15-year period and to study interactions between risk factors known before delivery.

Key message

Obstetric anal sphincter injuries may be prevented by using perineal support, securing a slow expulsion speed, and by use of a lateral episiotomy in nulliparous women having an instrumental delivery.

2 | MATERIAL AND METHODS

The labor ward at Stavanger University Hospital is the only delivery unit in the region, with around 4500 annual deliveries. We conducted a historical cohort study from 1999 to 2021. The main outcome measure was OASIS rates as defined by the International Continence Society, which is a partial or complete tear of the anal sphincter muscles, with or without disruption of the anal mucosa (grades 3–4 perineal tears). The diagnosis was based on clinical examinations at delivery. Data were collected from the obstetrical database of the labor ward from 1999 to May 2008, and thereafter from the structured NATUS® medical record.

Data were organized in accordance with the Robson ten group classification system (TGCS),[26] and we included women without a previous cesarean section and with a single fetus in cephalic presentation at pregnancy length ≥37 weeks. Nulliparous women with spontaneous labor onset comprised TGCS group one, nulliparous women with induced labors group two, parous women with spontaneous labor onset group three and parous women with induced labors group four. Excluded were women with prelabor or intrapartum cesarean sections.

Obstetricians performed the instrumental deliveries, while midwifes led normal births. Before 2004, birth attendants decided case-based on maternal birth position, perineal support and episiotomy. After the visit of the Directory of Health in 2004, more attention was paid to OASIS; however, without training. Mediolateral episiotomy was the preferred method before 2007. An obstetrician from Finland visited the labor ward in January 2007, and presented the Finnish concept in a lecture for all staff. During the first 6 months of 2007, all obstetricians and midwives undertook a mandatory hands-on training in accordance with the Finnish concept of active perineal protection.[27] One hand should support the perineum and the other hand should be placed on the fetal head to control the speed of fetal expulsion. The concept included effective communication with the mother and close observation of perineal stretching. The obstetrician performing instrumental deliveries used one hand on the instrument to control the expulsion speed and the other hand

for perineal protection. All women were laying on their back during the expulsive phase.

The supervisors from Finland recommended a change from mediolateral to lateral episiotomy when indicated, and this new routine was implemented simultaneously with the Finnish concept of perineal protection in January 2007. These routines have been mandatory from 2007 and onward, and new staff members are trained in the procedures. Two midwives are present during the expulsive phase ensuring that the routines are followed.

Instrumental vaginal delivery was considered after 60 min of active pushing, and a metal cup was the preferred device. Fetal position was diagnosed at delivery. Oxytocin augmentation was defined as oxytocin used to stimulate contractions during established labor, and was administered as an intravenous infusion of 5 mU/min, with dose increments of 2.5 mU every 15 min to a maximum of 30 mU/min until progress of labor or regular contractions was achieved. Epidural analgesia was the first choice for pain relief and given as bupivacaine or ropivacaine combined with fentanyl.

2.1 | Statistical analysis

We stratified results into two periods, 1999–2006 (before implementing new guidelines) and 2007–2121 (after period). Yearly variations in OASIS rates and episiotomy rates are presented graphically.

Categorical variables were compared with chi-square test and trends were analyzed with linear-by-linear association. The associations between OASIS and maternal and fetal characteristics, and labor interventions were first analyzed in a multivariable logistic regression analysis. Thereafter, we performed stratified analyses with the variables instrumental deliveries vs spontaneous deliveries, occiput anterior (OA) vs OP positions at delivery and with and without use of episiotomy. Logistic regression analyzes were used to calculate odds ratios and results were adjusted for possible confounders known before the episiotomy eventually was performed (maternal age, gestational age, epidural analgesia, and oxytocin augmentation). We missed information about maternal age in one case, gestational age was unreliable coded (>305 days) or with missing information in 31 cases (0.04%) and birthweight was unreliable coded (<1500 g or >6500 g) or with missing information in 126 (0.16%). These cases were excluded from the multivariable regression analyses. p-values < 0.05 were considered significant. Data were analyzed using IBM SPSS statistics for Windows version 26.0 (IBM Corporation).

3 | RESULTS

3.1 | Study population

The labor ward had 103 681 deliveries during the study period, of whom 85 617 women were classified in TGCS groups 1 to 4; 27 937 women in the period 1999–2006 and 57 680 women in the period 2007–2021. The cesarean section rates in TGCS group 1–4 showed an increasing trend and were 5.8% (range 3.5%–7.5%) in the first period and 6.7% (range 5.2%–7.9%) in the second period. After exclusion of 5480 women who were delivered by cesarean section, the final study population comprised 80 137 women (Figure 1). Table 1 presents characteristics of the study population in four TGCS groups by study period.

3.2 | OASIS and episiotomy rates

We observed a significant reduction in OASIS rates in all four TGCS groups after implementation of the new routines in 2007, and the OASIS rates were stable during a 15-year period. The overall OASIS rate fell from 4.9% in the period 1999–2006 to 1.9% in the period 2007–2021. A moderate fall in OASIS rates started in the period 2004–2006, and a stable rate around 2% was achieved from 2007 onwards. The OASIS rates differed in the four TGCS groups and were 8.8%, 11.2%, 2.1% and 2.9% in the first period, and 3.4%, 3.7%, 0.9% and 1.0% in the second period, respectively. The yearly variation in OASIS rates is shown in Figure 2.

The use of episiotomy was reduced from year 2000–2006 but increased after 2007. The episiotomy rates differed in the four TGCS groups, and were 26.3%, 32.8%, 5.6% and 7.3% in the first period and 40.1%, 48.2%, 6.5% and 10.2% in the second period, respectively. The yearly variation in episiotomy rates is shown in Figure 3.

We merged further analyses for TGCS groups 1 and 2 (nulliparous women) and groups 3 and 4 (parous women without a previous cesarean section) as the OASIS rates were similar.

3.3 | Risk factors for OASIS

We found that increasing maternal age, increasing gestational age, birthweight >4000 g, oxytocin augmentation and instrumental delivery were associated with increased OASIS rates in nulliparous and parous women in both periods. The association with fetal position, episiotomy and epidural analgesia varied between the groups (Table 2).

3.4 | Interactions between episiotomy, delivery mode and fetal position

The overall frequencies of episiotomy were 14.4% vs 21.8%, instrumental vaginal deliveries 11.3% vs 14.8% and persistent OP positions 4.0% vs 5.5%, in the two periods, respectively. Figure 4 displays episiotomy rates by parity in spontaneous and instrumental deliveries during the study period.

In the period 1999–2006 instrumental vaginal delivery rates in nulliparous women were 21.4% in OA deliveries vs 58.8% in OP deliveries ($p < 0.01$). In parous women the corresponding rates were 2.9% vs 17.2%, ($p < 0.01$). Mediolateral episiotomy was significantly

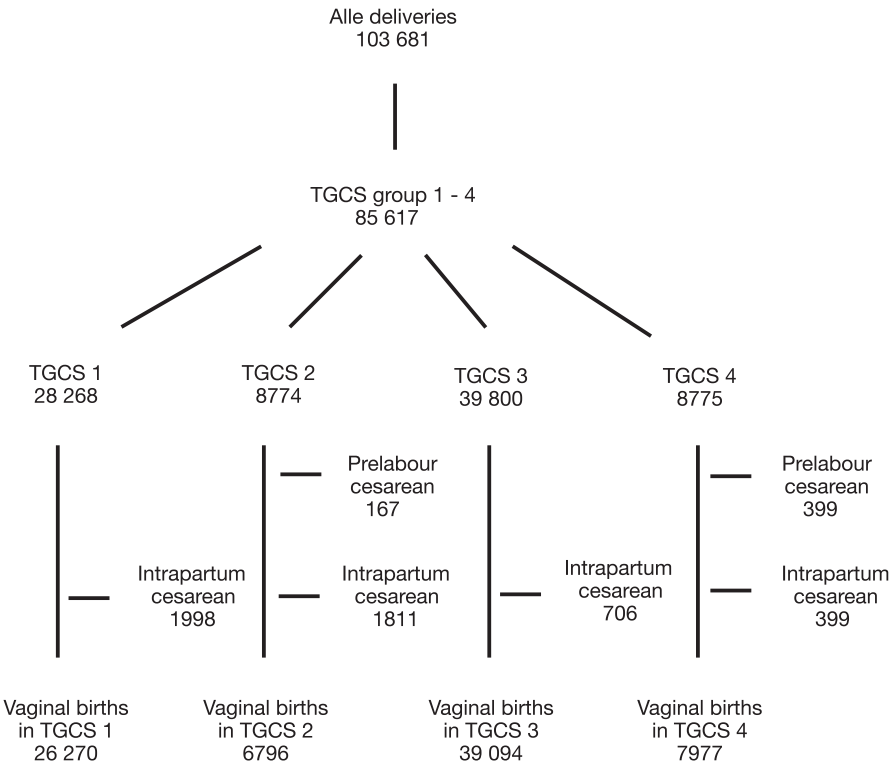

FIGURE 1 Flow chart of the study population.

associated with higher OASIS rate in nulliparous women with a spontaneous delivery and persistent OP position, and in all parous women with spontaneous deliveries (Table 3).

In the period 2007–2021 the instrumental vaginal delivery rates in nulliparous women were 27.7% in OA deliveries vs 56.1% in OP deliveries ($p < 0.01$) and in parous women the corresponding rates were 3.9% vs 13.5% ($p < 0.01$). Lateral episiotomy was associated with lower OASIS rates in nulliparous women with instrumental vaginal deliveries and OA position, 3.4% vs 10.1% (OR 0.31; 95% CI: 0.24–0.40) and 6.1 vs 13.9% (OR 0.40; 95% CI: 0.19–0.82) in women with OP position. Lateral episiotomy was also associated with significantly lower OASIS rates in nulliparous women with spontaneous deliveries and OA position, 2.1% vs 3.2% (OR 0.62; 95% CI: 0.49–0.80). The difference was not significant in spontaneous deliveries with persistent OP position, 2.3% vs 3.1% (OR 0.82; 95% CI: 0.25–2.69), but this group comprised few cases (Table 3). Lateral episiotomy was associated with significantly higher OASIS rates in parous women with a spontaneous delivery and OA position. The four possible confounders maternal age, gestational age, epidural analgesia, and oxytocin augmentation had little confounding effects on the risk of OASIS (Table 3).

4 | DISCUSSION

We observed a significant and long-lasting reduction in OASIS rates after implementation of the preventive procedures in 2007. In the period 2007–2021, the OASIS rates were less than half in nulliparous women delivered instrumentally if episiotomy was done (Table 3). The highest OASIS rates were found in nulliparous women with an instrumental vaginal delivery, persistent OP position and no episiotomy.

Nulliparous women have a higher risk of OASIS in an instrumental than a spontaneous birth,[3,4] and forceps have higher risk than vacuum deliveries.[19] In a study from the Netherlands OASIS rates were 3.0% (95% CI: 2.8%–3.3%) in vacuum deliveries and 4.7% (95% CI: 4.2%–5.2%) in forceps deliveries.[23] The possible benefits of reduced OASIS rates when using episiotomy in instrumental deliveries should be balanced against maternal discomfort. A study from France reported that a restrictive mediolateral episiotomy policy for operative deliveries was associated with an increase in OASIS rates with forceps, but not with vacuum.[28] The French guidelines now favor a restrictive policy of episiotomy and a massive decrease in episiotomy rates in instrumental deliveries was only associated with a slight increase in OASIS rates in nulliparous women; from 2.9% to 3.3%.[29] In line with other studies,[30–32] we found that episiotomy was significantly associated with lower OASIS rates in nulliparous women with an instrumental delivery. In our department vacuum extraction comprised >10% of all deliveries, and forceps less than 1% of all deliveries. One study recommends that episiotomy should be included in a global management of instrumental vaginal deliveries in nulliparous women,[24] and our results support such a policy.

We found that lateral episiotomy was associated with significant lower OASIS rates also in spontaneous deliveries in nulliparous women, however, the association was weaker than for instrumental deliveries. One study used a matched pair design and concluded that associations should be interpreted with caution due to confounding by indication, because episiotomy is more often used in high-risk women.[17] One randomized controlled trial could not conclude whether a policy

TABLE 1 Study population characteristics 1999–2006 and 2007–2021.

	1999–2006			
	Robson ten-group classification system 1	Robson ten-group classification system 2	Robson ten-group classification system 3	Robson ten-group classification system 4
	Mean (SD) or %			
	n = 9005	*n* = 1541	*n* = 13 964	*n* = 1814
Maternal age (years)	26.9 (4.5)	27.8 (5.1)	30.9 (4.4)	31.6 (4.5)
Gestational age (days)	281(7.6)	284 (11.7)	282 (7.9)	282 (11.7)
Epidural analgesia	42.2	66.4	17.0	38.3
Oxytocin augmentation	46.9	9.7	16.0	5.6
Episiotomy	26.3	32.8	5.6	7.3
Instrumental vaginal delivery	21.5	31.6	3.2	5.7
Forceps	1.8	2.5	0.2	0.7
Occiput posterior position	4.0	5.7	3.8	3.7
Birthweight >4000 g	14.3	21.1	24.6	32.4
	2007–2021			
	n = 17 265	*n* = 5255	*n* = 25 130	*n* = 6163
Maternal age (years)	28.0 (4.5)	28.4 (5.1)	31.4 (4.4)	32.1(4.7)
Gestational age (days)	281 (7.6)	284 (10.0)	281 (7.1)	282 (10.0)
Epidural analgesia	44.7	70.9	20.3	43.0
Oxytocin augmentation	31.9	32.3	6.7	13.2
Episiotomy	40.1	48.2	6.5	10.2
Instrumentalvaginal delivery	26.8	37.3	3.9	6.8
Forceps	1.2	1.8	0.1	0.3
Occiput posterior position	5.4	5.4	5.5	5.4
Birthweight >4000 g	10.6	15.8	20.5	28.4

of routine episiotomy was better or worse than a restrictive policy.[13] The World Health Organization does not recommend routine use of episiotomy in spontaneous deliveries in their new guidelines.[22] In a Cochrane review the authors conclude that selective episiotomy policies result in fewer women with severe perineal trauma.[18]

It was a surprise that the episiotomy rates increased that much among parous women without observing any benefits on OASIS rates, and this finding is important for future management of parous women in our department. One part of the Finnish concept is close observation of the perineum. We think that this attention to stretching of the soft tissue in the perineum has resulted in an increase in the use of episiotomy. Even though the indications for episiotomy were universal for all staff, the practice may have varied between experienced and unexperienced midwives and physicians. Higher episiotomy rates in the second delivery have been reported for women who had an episiotomy in their first delivery,[33] which may explain the higher OASIS rate if the new episiotomy was placed in the old scar.

A mediolateral episiotomy is commencing from the posterior part of the fourchette, and a lateral episiotomy is as an incision commencing ≥10 mm lateral to the posterior fourchette, directed towards the ischial tuberosity.[14] One study did not find any difference in outcomes between mediolateral vs lateral episiotomy;[34] however, other studies found a wide angle and a lateral incision point associated with lower OASIS rates.[16,35] A randomized controlled trial compared a 40-degree angled episiotomy with a 60-degree angle and found significantly higher short-term-related pain in the group with a wide angle. Further, a wide angle was associated with lower rate of OASIS but the difference did not reach statistical significance.[36] Another study did not find more short- or long-term pain when a lateral incision was used.[14,37] One study has shown a great variation in self-reported episiotomy,[25] and we do not know if all episiotomies in our unit fulfilled the criteria for being lateral, but we believe that the incisions are more lateral than they were before the training program started.

The OASIS rates in our department from 2007 onwards are similar to national Norwegian OASIS rates.[38] The OASIS rates started to fall before 2007 (Figure 2). The Norwegian Directorate of Health made a supervision of our labor ward in 2004 and pointed at the very high OASIS rates. At that time, the staff was aware of the Finnish concept and may have paid more attention to perineal protection in an unsystematic approach. In retrospect, we have observed that mediolateral episiotomy rates had fallen since around year 2000. These actions may explain the falling OASIS

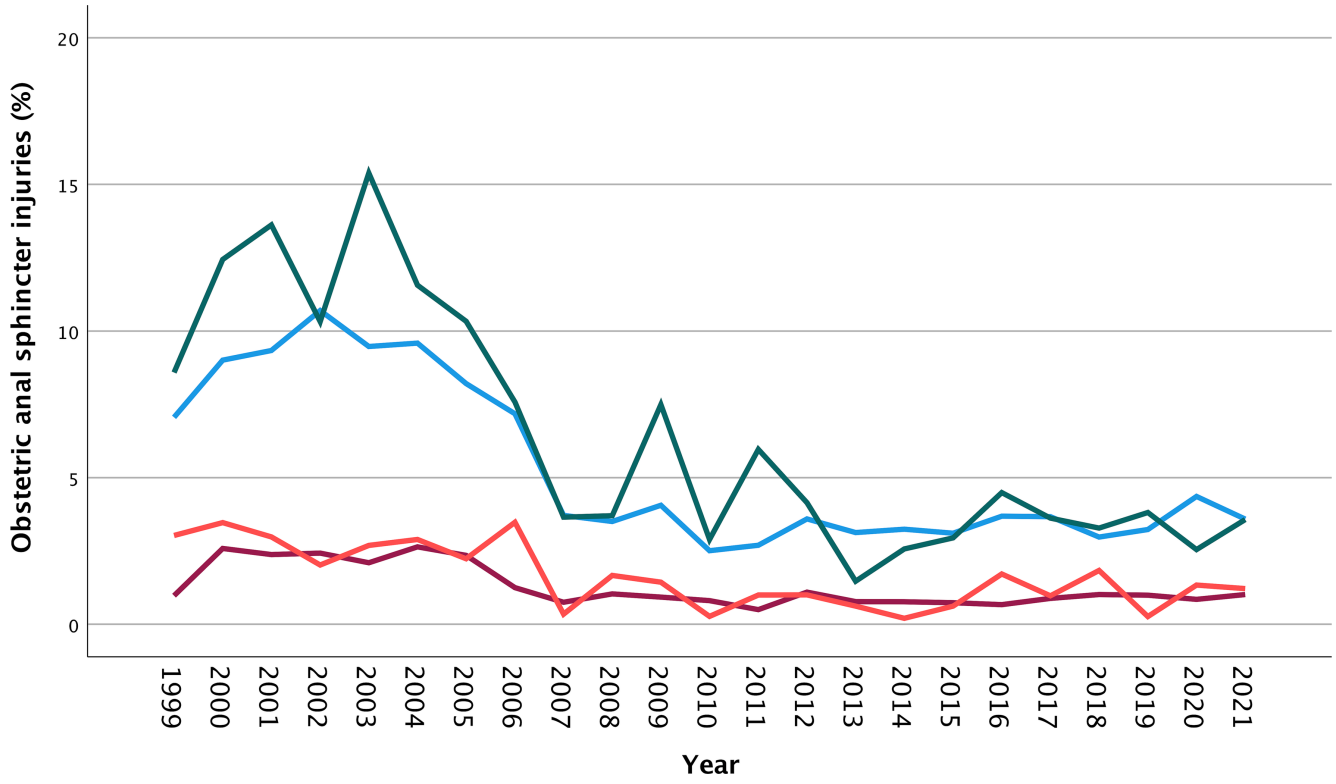

FIGURE 2 Obstetric anal sphincter injuries rates during the study period differentiated in accordance with the Robson ten-group classification system. Blue line represents Robson ten-group classification system group 1, green line group 2, brown line group 3 and red line group 4

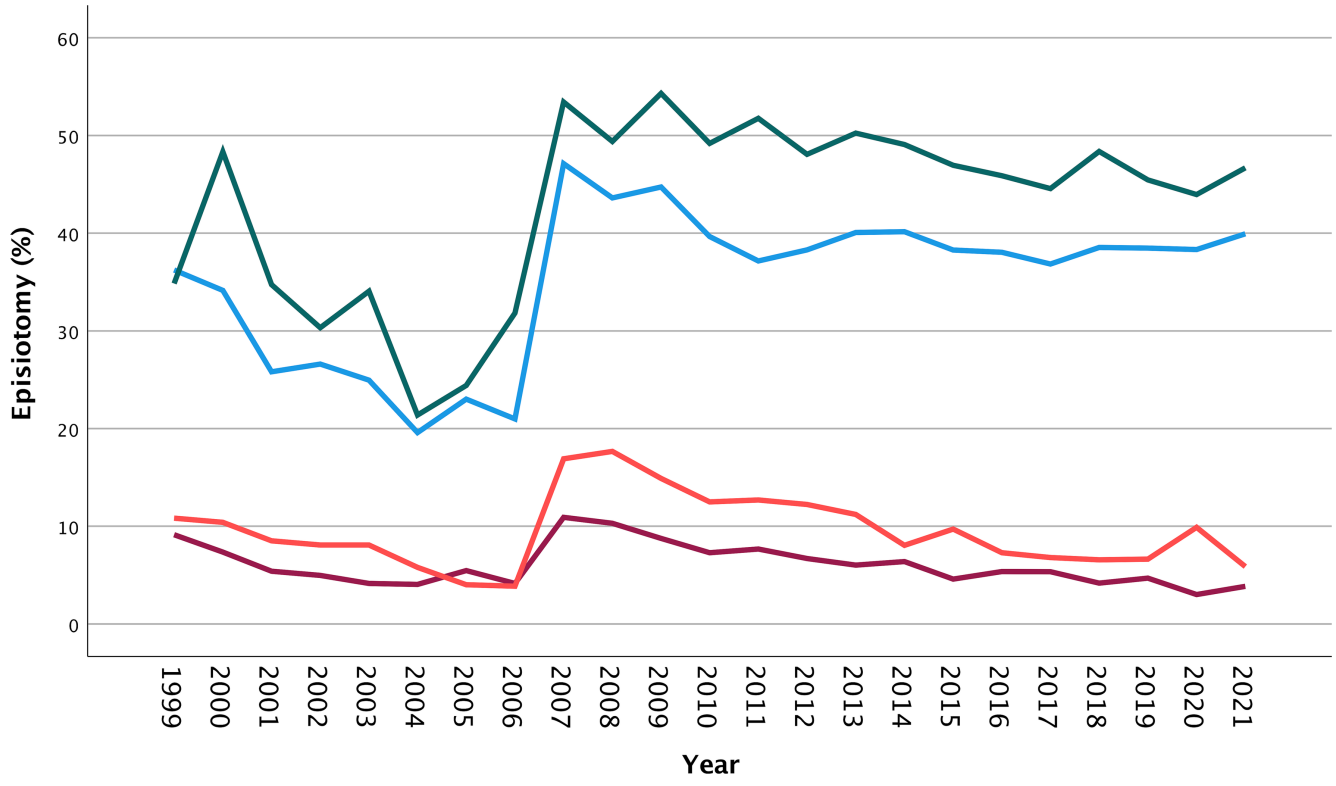

FIGURE 3 Episiotomy rates during the study period differentiated in accordance with the Robson ten-group classification system. Blue line represents Robson ten-group classification system group 1, green line group 2, brown line group 3 and red line group 4.

TABLE 2 Associations between obstetrical anal sphincter injuries and risk factors analyzed with logistic regression analyses.

	1999–2006		2007–2021	
	Unadjusted OR	Adjusted OR	Unadjusted OR	Adjusted OR
Robson ten-group classification system 1 + 2				
Maternal age (days)	1.05 (1.03–1.06)	1.03 (1.02–1.05)	1.03 (1.01–1.04)	1.03 (1.01–1.04)
Gestational age (weeks)	1.27 (1.21–1.34)	1.15 (1.09–1.22)	1.19 (1.12–1.27)	1.13 (1.06–1.20)
Epidural analgesia	1.04 (0.91–1.19)	0.76 (0.66–0.88)	0.99 (0.86–1.15)	0.80 (0.69–0.94)
Oxytocin augmentation	1.41 (1.23–1.61)	1.19 (1.03–1.38)	1.31 (1.13–1.52)	1.21 (1.02–1.42)
Episiotomy	1.36 (1.19–1.57)	1.00 (0.86–1.16)	0.81 (0.69–0.93)	0.44 (0.36–0.53)
Instrumental vaginal	2.79 (2.43–3.20)	2.45 (2.10–2.85)	1.64 (1.42–1.90)	2.37 (1.95–2.88)
OP position	1.65 (1.25–2.17)	1.22 (0.92–1.64)	1.57 (1.21–2.05)	1.51 (1.15–1.98)
BW >4000	2.39 (2.05–2.78)	2.00 (1.70–2.35)	2.13 (1.79–2.54)	1.95 (1.63–2.35)
Robson ten-group classification system 3 + 4				
Maternal age (days)	1.01 (0.99–1.04)	1.01 (0.98–1.03)	1.0 (1.00–1.06)	1.02 (0.99–1.05)
Gestational age (weeks)	1.23 (1.12–1.34)	1.05 (0.95–1.15)	1.29 (1.16–1.44)	1.14 (1.02–1.28)
Epidural analgesia	1.15 (0.88–1.49)	0.83 (0.62–1.10)	0.95 (0.72–1.25)	0.75 (0.55–1.01)
Oxytocin augmentation	1.75 (1.36–2.26)	1.30 (0.98–1.74)	1.18 (1.28–2.57)	1.52 (1.04–2.23)
Episiotomy	2.95 (2.14–4.00)	2.15 (1.56–2.96)	2.37 (1.70–3.30)	1.74 (1.20–2.51)
Instrumental vaginal	4.54 (3.27–6.28)	2.93 (2.04–4.22)	2.59 (1.76–3.82)	1.66 (1.06–2.59)
OP position	2.32 (1.56–3.45)	1.58 (1.04–2.40)	1.59 (1.03–2.44)	1.41 (0.91–2.18)
BW >4000	3.08 (2.48–3.82)	2.73 (2.17–3.44)	2.56 (2.01–3.26)	2.24 (1.73–2.89)

Abbreviations: BW, birthweight; OP, occiput posterior; OR, odds ratio.

FIGURE 4 Episiotomy rates during the study period. Nulliparous women to the left and parous women to the right. The green line represents instrumental vaginal deliveries and the blue line spontaneous deliveries.

rates observed over the years 2004–2006. Others have reported falling OASIS rates at time when the use of mediolateral episiotomy rates fell.[39]

Causative relations should be interpreted with caution.[40] Even though we observed a reduction in OASIS rates from 2004 and onwards, the largest reduction was observed from the year 2006 to 2007. In January 2007 the Finnish concept was implemented at the same time as the use of lateral episiotomy. The episiotomy rates doubled during that year and remained high in the subsequent years without a further reduction in OASIS rates as time passed by. It is difficult to dissect the role of lateral episiotomy when explaining the abrupt fall in OASIS rates over the years 2006 to 2007 as the Finnish concept comprises several measures. However, the episiotomy rate was much higher in instrumental deliveries than in spontaneous deliveries (Figure 4). Therefore, we consider that the reduced OASIS rates in spontaneous deliveries are mainly explained by using perineal support and controlled speed of expulsion, while the use of episiotomy may have contributed more to the prevention of OASIS in instrumental deliveries. A Danish department achieved reduction in OASIS rates after implementation of perineal support and "hand on fetal head" similar to our results while maintaining low episiotomy rates.[41] This lack of consistency between the Danish and our results reduce the impact of lateral episiotomy in prevention of OASIS (the second Bradford-Hill criteria).[40]

TABLE 3 Interactions between instrumental vaginal delivery, occiput posterior position and episiotomy on risk of OASIS in 1996–2006 and 2007–2021.

		Episiotomy +	Episiotomy −		
	n	OASIS *n* (%)		Unadjusted OR	Adjusted OR
1999–2006					
Robson ten-group classification system 1 + 2					
Spontaneous vaginal OA-position	7941	130 (7.6)	405 (6.5)	1.17 (0.96–1.44)	1.09 (0.89–1.34)
Instrumental vaginal OA-position	2158	150 (16.3)	214 (17.3)	0.93 (0.74–1.17)	0.91 (0.72–1.14)
Spontaneous vaginal OP-position	184	11 (15.7)	6 (5.3)	3.36 (1.18–9.53)	3.19 (1.10–9.31)
Instrumental vaginal OP-position	263	27 (17.1)	18 (17.1)	1.00 (0.52–1.92)	1.00 (0.51–1.94)
Robson ten-group classification system 3 + 4					
Spontaneous vaginal OA-position	14738	34 (4.5)	247 (1.8)	2.63 (1.82–3.79)	2.49 (1.72–3.60)
Instrumental vaginal OA-position	441	8 (8.9)	25 (7.1)	1.27 (0.55–2.92)	1.37 (0.59–3.17)
Spontaneous vaginal OP-position	496	5 (11.4)	11 (2.4)	5.14 (1.70–15.54)	4.75 (1.55–14.60)
Operative vaginal OP-position	103	4 (13.3)	8 (11.0)	1.25 (0.35–4.51)	1.03 (0.27–3.92)
2007–2021					
Robson ten-group classification system 1 + 2					
Spontaneous vaginal OA-position	15401	79 (2.1)	372 (3.2)	0.66 (0.52–0.84)	0.62 (0.49–0.80)
Instrumental vaginal OA-position	5899	167 (3.4)	95 (10.1)	0.31 (0.24–0.41)	0.31 (0.24–0.40)
Spontaneous vaginal OP-position	536	4 (2.3)	11 (3.1)	0.73 (0.23–2.33)	0.82 (0.25–2.69)
Instrumental vaginal OP-position	684	37 (6.1)	11 (13.9)	0.40 (0.20–0.83)	0.40 (0.19–0.82)
Robson ten-group classification system 3 + 4					
Spontaneous vaginal OA-position	28416	26 (1.7)	204 (0.8)	2.30 (1.53–3.47)	2.15 (1.42–3.26)
Instrumental vaginal OA-position	1157	11 (2.2)	9 (1.4)	1.60 (0.66–3.90)	1.58 (0.65–3.86)
Spontaneous vaginal OP-position	1487	1 (0.8)	13 (1.0)	0.78 (0.10–6.02)	0.63 (0.08–4.91)
Instrumental vaginal OP-position	233	4 (3.6)	5 (4.1)	0.88 (0.23–3.34)	0.80 (0.20–3.20)

Note: Odds ratios are adjusted for maternal age (years), gestational age (weeks), epidural analgesia and oxytocin augmentation.
Abbreviations: OASIS, obstetric anal sphincter injuries; OA, occiput anterior; OP, occiput posterior; OR, odds ratio.

The four possible confounders maternal age, gestational age, epidural analgesia, and oxytocin augmentation were risk factors in the logistic regression analyses (Table 2) but had little confounding effects on risk of OASIS in the stratified analyses in groups with and without episiotomy (Table 3). Therefore, parity, instrumental delivery, and fetal position are the variables needed to be considered before making an episiotomy. The induction rates increased during the study period, which may partly explain the reduced rates of birthweight >4000 g (Table 1). Fewer large babies may have contributed to reduced OASIS rates. Birthweight is not known before delivery and therefore not included in our model that assessed confounding (Table 3).

Bulchandani et al. performed a systematic review and included five randomized controlled trials and seven nonrandomized studies.[42] The randomized trials did not demonstrate a statistically significant protective effect of manual perineal support, but a significant reduction in the risk of OASIS rates was shown in the nonrandomized studies. In a Cochrane review massage of the perineum and the use of warm compresses were associated with reduced risk OASIS, however the data were insufficient to conclude on the efficacy of other perineal techniques.[43] It has been questioned if evidence should be solely based on randomized clinical trials.[20] After implementation of the perineal support a huge reduction in perineal tears has been documented in observational studies of high quality,[8–12] but the strength of the evidence is still under discussion.[44] Our study confirms the findings from the previous observational studies. An immediate effect is frequently seen after the implementation of new routines, and may be due to the Hawthorn effect;[45] however, we have seen a long-lasting effect of the training program.

The Finnish concept may be associated with adverse events. The expulsion phase may be longer, which may increase the risk of fetal asphyxia in some cases. We did not include fetal outcomes in our study, but the overall rates of Apgar <7 after 5 min in our department are available from the Medical Birth Registry of Norway. Over the study years the annual rates varied between 1.4% and 2.2% (chi-square trend, $p = 0.98$).[38]

We observed high operative delivery rates in OP positions, more than 50% in nulliparous women. The fetal head is broader posteriorly than anteriorly, and OP position is a known risk factor for OASIS.[7,23,46] OP position in instrumental deliveries is a high risk situation,[46,47] which also is shown in our study. Persistent OP position can be diagnosed clinically before delivery; however, a high failure rate has been reported.[48] Ultrasound has

high accuracy in detecting fetal position.[49] During the last years, we examined fetal position with ultrasound before instrumental deliveries and when a malposition was suspected, as recommended by the International Society of Ultrasound in Obstetrics and Gynecology.[50] Therefore, persistent OP position was usually known before delivery at the end of the period, which may have contributed to reduced OASIS rates.

The strengths of the present study are inclusion of a large study population and a long observational period after implementation of the preventive strategies (15 years). Labor outcomes which varies between different groups and stratifying the women in accordance with the TGCS is a strength. We analyzed the associations between OASIS and episiotomy in stratified analyses with spontaneous or instrumental deliveries and OA or OP positions at delivery. It is a strength that we only adjusted for possible confounders known at the time before a decision of episiotomy.

The main limitation is the historical design, and possible causative relations should be interpreted with caution. Some OASIS may have been overlooked. The diagnosis may be more challenging in women with an intact perineum, and possibly after a lateral episiotomy. Ultrasound was not used to diagnose OASIS. It is a limitation that we do not know the rates of anal incontinence in the population.

5 | CONCLUSION

We observed a long-lasting reduction in OASIS rates after implementation of preventive procedures. Episiotomy was associated with lower OASIS rates in nulliparous women with an instrumental delivery. Special attention should be paid to deliveries with persistent OP position. We recommend using perineal support and control of expulsion speed in all deliveries and routine use of lateral episiotomy in nulliparous women delivered instrumentally.

AUTHOR CONTRIBUTIONS

Torbjørn M. Eggebø and Finn Egil Skjeldestad planned the study, performed statistical analyses and were mainly responsible for writing the manuscript. Astrid Betten Rygh participated in planning of the study and writing of the manuscript. Phillip von Brandis was responsible for creating the data file, quality assurance of the calculations, and participated in writing of the manuscript.

ACKNOWLEDGMENTS

We would like to thank Jouko Pirhonen and Tina Pirhonen for teaching the staff in preventive strategies. We would also thank Lilly Kleppa for the contining education of new staff members.

FUNDING INFORMATION

This manuscript has no external funding

CONFLICT OF INTEREST STATEMENT

The authors report no conflict of interest.

ETHICS STATEMENT

The regional ethics committee in Western Norway assessed the study as a quality assurance study (REK 2022/427040) on March 8, 2022. The study was approved by the data protection officer at Stavanger University Hospital May 10, 2022.

ORCID

Torbjørn M. Eggebø https://orcid.org/0000-0002-3162-9595
Finn Egil Skjeldestad https://orcid.org/0000-0001-9875-4991

REFERENCES

1. Rygh AB, Korner H. The overlap technique versus end-to-end approximation technique for primary repair of obstetric anal sphincter rupture: a randomized controlled study. *Acta Obstet Gynecol Scand*. 2010;89:1256-1262.
2. Zimmo K, Laine K, Vikanes A, et al. Diagnosis and repair of perineal injuries: knowledge before and after expert training-a multicentre observational study among Palestinian physicians and midwives. *BMJ Open*. 2017;7:e014183.
3. Baghestan E, Irgens LM, Bordahl PE, Rasmussen S. Trends in risk factors for obstetric anal sphincter injuries in Norway. *Obstet Gynecol*. 2010;116:25-34.
4. Rygh AB, Skjeldestad FE, Korner H, Eggebo TM. Assessing the association of oxytocin augmentation with obstetric anal sphincter injury in nulliparous women: a population-based, case-control study. *BMJ Open*. 2014;4:e004592.
5. Selmer-Olsen T, Nohr EA, Tappert C, Eggebo TM. Incidence and risk factors for obstetric anal sphincter ruptures, OASIS, following the introduction of preventive interventions. A retrospective cohort study from a Norwegian hospital 2012-2017. *Sex Reprod Healthc*. 2019;22:100460.
6. Tunestveit JW, Baghestan E, Natvig GK, Eide GE, Nilsen ABV. Factors associated with obstetric anal sphincter injuries in midwife-led birth: a cross sectional study. *Midwifery*. 2018;62:264-272.
7. Eskandar O, Shet D. Risk factors for 3rd and 4th degree perineal tear. *J Obstet Gynaecol*. 2009;29:119-122.
8. Laine K, Gissler M, Pirhonen J. Changing incidence of anal sphincter tears in four Nordic countries through the last decades. *Eur J Obstet Gynecol Reprod Biol*. 2009;146:71-75.
9. Hals E, Oian P, Pirhonen T, et al. A multicenter interventional program to reduce the incidence of anal sphincter tears. *Obstet Gynecol*. 2010;116:901-908.
10. Laine K, Pirhonen T, Rolland R, Pirhonen J. Decreasing the incidence of anal sphincter tears during delivery. *Obstet Gynecol*. 2008;111:1053-1057.
11. Stedenfeldt M, Oian P, Gissler M, Blix E, Pirhonen J. Risk factors for obstetric anal sphincter injury after a successful multicentre interventional programme. *BJOG*. 2014;121:83-91.
12. Laine K, Skjeldestad FE, Sandvik L, Staff AC. Incidence of obstetric anal sphincter injuries after training to protect the perineum: cohort study. *BMJ Open*. 2012;2:e001649.
13. Murphy DJ, Macleod M, Bahl R, Goyder K, Howarth L, Strachan B. A randomised controlled trial of routine versus restrictive use of episiotomy at operative vaginal delivery: a multicentre pilot study. *BJOG*. 2008;115:1695-1703.
14. Fodstad K, Laine K, Staff AC. Different episiotomy techniques, postpartum perineal pain, and blood loss: an observational study. *Int Urogynecol J*. 2013;24:865-872.
15. Raisanen S, Cartwright R, Gissler M, et al. Changing associations of episiotomy and anal sphincter injury across risk strata: results of a population-based register study in Finland 2004-2011. *BMJ Open*. 2013;3:e003216.

16. Eogan M, Daly L, O'Connell PR, O'Herlihy C. Does the angle of episiotomy affect the incidence of anal sphincter injury? *BJOG*. 2006;113:190-194.
17. Raisanen S, Selander T, Cartwright R, et al. The Association of Episiotomy with obstetric anal sphincter injury–a population based matched cohort study. *PloS One*. 2014;9:e107053.
18. Jiang H, Qian X, Carroli G, Garner P. Selective versus routine use of episiotomy for vaginal birth. *Cochrane Database Syst Rev*. 2017;2:CD000081.
19. Andrews V, Sultan AH, Thakar R, Jones PW. Risk factors for obstetric anal sphincter injury: a prospective study. *Birth*. 2006;33:117-122.
20. Sultan AH, Thakar R, Ismail KM, et al. The role of mediolateral episiotomy during operative vaginal delivery. *Eur J Obstet Gynecol Reprod Biol*. 2019;240:192-196.
21. Myers-Helfgott MG, Helfgott AW. Routine use of episiotomy in modern obstetrics. Should it be performed? *Obstet Gynecol Clin North Am*. 1999;26:305-325.
22. World Health Organization. Intrapartum Care for a Positive Childbirth Experience. 2020. Geneva: World Health Organization.
23. de Leeuw JW, de Wit C, Kuijken JP, Bruinse HW. Mediolateral episiotomy reduces the risk for anal sphincter injury during operative vaginal delivery. *BJOG*. 2008;115:104-108.
24. Boujenah J, Tigaizin A, Fermaut M, et al. Is episiotomy worthwile to prevent obstetric anal sphincter injury during operative vaginal delivery in nulliparous women? *Eur J Obstet Gynecol Reprod Biol*. 2019;232:60-64.
25. Fodstad K, Staff AC, Laine K. Episiotomy preferences, indication, and classification – a survey among Nordic doctors. *Acta Obstet Gynecol Scand*. 2016;95:587-595.
26. Robson MS. Can we reduce the caesarean section rate? *Best Pract Res Clin Obstet Gynaecol*. 2001;15:179-194.
27. Kleprlikova H, Kalis V, Lucovnik M, et al. Manual perineal protection: the know-how and the know-why. *Acta Obstet Gynecol Scand*. 2020;99:445-450.
28. Gachon B, Fradet Menard C, Pierre F, Fritel X. Does the implementation of a restrictive episiotomy policy for operative deliveries increase the risk of obstetric anal sphincter injury? *Arch Gynecol Obstet*. 2019;300:87-94.
29. Gachon B, Fritel X, Riviere O, Pereira B, Vendittelli F. French guidelines for restrictive episiotomy during instrumental delivery were not followed by an increase in obstetric anal sphincter injury. *Sci Rep*. 2022;12:6330.
30. Raisanen S, Laine K, Jouhki MR, Vehvilainen-Julkunen K, Gissler M, Heinonen S. risk of obstetric anal sphincter injury in vaginal births could be reduced. *Duodecim*. 2012;128:1981-1987.
31. van Bavel J, Hukkelhoven C, de Vries C, et al. The effectiveness of mediolateral episiotomy in preventing obstetric anal sphincter injuries during operative vaginal delivery: a ten-year analysis of a national registry. *Int Urogynecol J*. 2018;29:407-413.
32. Jango H, Langhoff-Roos J, Rosthoj S, Sakse A. Modifiable risk factors of obstetric anal sphincter injury in primiparous women: a population-based cohort study. *Am J Obstet Gynecol*. 2014;210(59):e51-e56.
33. Manzanares S, Cobo D, Moreno-Martinez MD, Sanchez-Gila M, Pineda A. Risk of episiotomy and perineal lacerations recurring after first delivery. *Birth*. 2013;40:307-311.
34. Karbanova J, Rusavy Z, Betincova L, Jansova M, Parizek A, Kalis V. Clinical evaluation of peripartum outcomes of mediolateral versus lateral episiotomy. *Int J Gynaecol Obstet*. 2014;124:72-76.
35. Stedenfeldt M, Pirhonen J, Blix E, Wilsgaard T, Vonen B, Oian P. Episiotomy characteristics and risks for obstetric anal sphincter injuries: a case-control study. *BJOG*. 2012;119:724-730.
36. El-Din AS, Kamal MM, Amin MA. Comparison between two incision angles of mediolateral episiotomy in primiparous women: a randomized controlled trial. *J Obstet Gynaecol Res*. 2014;40:1877-1882.
37. Fodstad K, Staff AC, Laine K. Effect of different episiotomy techniques on perineal pain and sexual activity 3 months after delivery. *Int Urogynecol J*. 2014;25:1629-1637.
38. The Medical Birth Registry. Spincter ruptures in Norway. 2022. Accessed October 6 2023. https://statistikkbank.fhi.no/mfr/
39. Sagi-Dain L, Sagi S. Morbidity associated with episiotomy in vacuum delivery: a systematic review and meta-analysis. *BJOG*. 2015;122:1073-1081.
40. Hill AB. The environment and disease: association or causation? *Proc R Soc Med*. 1965;58:295-300.
41. Rasmussen OB, Yding A, Andersen CS, Boris J, Lauszus FF. Which elements were significant in reducing obstetric anal sphincter injury? A prospective follow-up study. *BMC Pregnancy Childbirth*. 2021;21:781.
42. Bulchandani S, Watts E, Sucharitha A, Yates D, Ismail KM. Manual perineal support at the time of childbirth: a systematic review and meta-analysis. *BJOG*. 2015;122:1157-1165.
43. Aasheim V, Nilsen ABV, Reinar LM, Lukasse M. Perineal techniques during the second stage of labour for reducing perineal trauma. *Cochrane Database Syst Rev*. 2017;6:CD006672.
44. Poulsen MO, Madsen ML, Skriver-Moller AC, Overgaard C. Does the Finnish intervention prevent obstetric anal sphincter injuries? A systematic review of the literature. *BMJ Open*. 2015;5:e008346.
45. Sedgwick P, Greenwood N. Understanding the Hawthorne effect. *BMJ*. 2015;351:h4672.
46. Benavides L, Wu JM, Hundley AF, Ivester TS, Visco AG. The impact of occiput posterior fetal head position on the risk of anal sphincter injury in forceps-assisted vaginal deliveries. *Am J Obstet Gynecol*. 2005;192:1702-1706.
47. Wu JM, Williams KS, Hundley AF, Connolly A, Visco AG. Occiput posterior fetal head position increases the risk of anal sphincter injury in vacuum-assisted deliveries. *Am J Obstet Gynecol*. 2005;193:525-528.
48. Akmal S, Tsoi E, Kametas N, Howard R, Nicolaides KH. Intrapartum sonography to determine fetal head position. *J Matern Fetal Neonatal Med*. 2002;12:172-177.
49. Ramphul M, Ooi PV, Burke G, et al. Instrumental delivery and ultrasound: a multicentre randomised controlled trial of ultrasound assessment of the fetal head position versus standard care as an approach to prevent morbidity at instrumental delivery. *BJOG*. 2014;121:1029-1038.
50. Ghi T, Eggebo T, Lees C, et al. ISUOG practice guidelines: intrapartum ultrasound. *Ultrasound Obstet Gynecol*. 2018;52:128-139.

How to cite this article: Eggebø TM, Rygh AB, von Brandis P, Skjeldestad FE. Prevention of obstetric anal sphincter injuries with perineal support and lateral episiotomy: A historical cohort study. *Acta Obstet Gynecol Scand*. 2024;103:488-497. doi:10.1111/aogs.14742