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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

Tone Selmer-Olsen[a,*], Ellen Aagaard Nohr[b,c], Christian Tappert[a], Torbjørn Moe Eggebø[d,e]

[a] Department of Obstetrics, Trondheim University Hospital (St. Olavs Hospital), Trondheim, Norway
[b] Research Unit of Gynecology and Obstetrics, Department of Clinical Research, University of Southern Denmark, Odense, Denmark
[c] Centre of Women's, Family and Child Health, University of South-Eastern Norway, Kongsberg, Norway
[d] Center for Fetal Medicine, Trondheim University Hospital (St. Olavs Hospital), Trondheim, Norway
[e] Institute of Clinical and Molecular Medicine, Norwegian University of Science and Technology, Trondheim, Norway

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ABSTRACT

Objective: A decrease of obstetric anal sphincter injuries (OASIS) was observed after preventive interventions were implemented at a Norwegian university hospital. The aim was to investigate whether the improvement had sustained over the following years.

Materials and methods: We performed a retrospective cohort study of 18 258 singleton vaginal cephalic births, ≥37 + 0 weeks of gestation during 2012–2017, examining data from the hospital's birth journals and separate registration forms. Interventions to prevent OASIS were implemented in 2011, and training in practical skills was repeated each year.

Main outcome measures: The main outcome was OASIS (n = 377).

Results: Frequency of OASIS overall decreased from 3.6% prior to 2011 to 2.1% after the intervention and sustained at that level throughout the study period. A trend of fewer OASIS among spontaneous deliveries, decreasing from 2.1% to 1.2% (p = 0.01) was observed, but no trend was seen for instrumental deliveries (p = 0.37), where the incidence fluctuated between 4.0% and 9.3% with an average of 6.5%. Primiparity, increased maternal age and increased fetal head circumference were associated with more OASIS in spontaneous deliveries. In instrumental deliveries, primiparity, occiput posterior position and increased fetal head circumference were associated with more OASIS, whilst episiotomy was associated with fewer OASIS.

Conclusion: The incidence of obstetric anal sphincter injuries maintained at a similar level of around 2.1% during the six following years after introducing preventive interventions. Regularly repetition and practical training seemed to be effective.

Introduction

Severe perineal tears involving the anal sphincter muscle are well-known complications to vaginal birth and can cause both immediate and long-term consequences for the mother [1]. For the best outcome, it is of immense importance that obstetric anal sphincter injuries (OASIS) are discovered, diagnosed and sutured correctly [2]. However, preventing severe ruptures from happening in the first place should be the goal for all midwives and obstetricians. Risk factors associated with OASIS include primiparity, maternal age, fetal head circumference, birth weight, instrumental delivery, episiotomy, and oxytocin augmentation [3–5]. In addition, trends in risk factors may change over time and thereby affect the incidence of OASIS [4].

The reported incidence of OASIS in Norway increased from 0.5% in 1967 to 4.1% in 2004 [4]. Similar increases were seen in the rest of the Nordic countries, except from Finland that had a much lower increase [6]. The Norwegian Directorate for Health published in 2006 a national action plan to reduce sphincter ruptures in Norway [7]. In a multicenter study, an intervention program to prevent OASIS was implemented in five Norwegian hospitals, and a significant decrease in OASIS was reported in the following years [8,9]. This intervention program included a bimanual perineal support technique also known as the "Finnish

Abbreviations: OASIS, obstetric anal sphincter injuries; FGM, female genital mutilation

* Corresponding author at: Department of Obstetrics (Birth), St. Olavs hospital, Postbox 3250 Torgarden, NO-7006 Trondheim, Norway.
E-mail address: tone.selmer-olsen@stolav.no (T. Selmer-Olsen).

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maneuver" [8–10]. The incidence of OASIS in Norway has decreased in later years, from 3.8% in all vaginal births in 2005 to 1.7% in 2017 [11].

The Norwegian university hospital, in which this study took place, experienced a total incidence of OASIS around 3.6% in the period 2007–2010, including 2.4% in spontaneous deliveries and 11.5% in instrumental deliveries [11]. The hospital implemented local preventive interventions in 2011 and observed a reduction in OASIS. An immediate reduction may be a result of the Hawthorne effect, where increased attention to a problem may lead to a change in behavior and temporary improvement of results during a study period [12]. Such improvements, however, are vulnerable to deteriorate over time. We therefore carried out a follow-up study which aim was to investigate whether the improvement had sustained over the following years. We also examined factors associated to OASIS, and studied any trends in these factors over time.

Material and methods

This was a retrospective cohort study, investigating OASIS in vaginal births after implementation of preventive interventions at a Norwegian university hospital. The labor ward is a tertiary center with approximately 3800 births per year, serving a local population of around 320 000 people and around 200 high-risk pregnancies referred from other hospitals yearly. Interventions expected to reduce the incidents of OASIS were implemented in 2011, and the study period included the next six years following the implementation. From 2012 to 2017, a total of 23 591 women delivered at the hospital. Our study period comprised a cohort of 18 258 women with a vaginal birth, a single fetus in cephalic presentation and $\geq 37 + 0$ weeks of gestation. During the study period, the staff at the labor ward comprised around 110 midwives and 40 obstetricians. In addition to trained staff, both midwifery students and doctors practicing to become specialists in obstetrics and gynecology attended births.

The intervention was initiated by an expert group of midwives and obstetricians in collaboration with clinicians from Oslo University Hospital, Ullevål, Norway. The intervention included teaching sessions with the staff, and practical training in assisting and slowing down the birth of the babýs head. The technique applied to both spontaneous and instrumental deliveries, by supporting both the head, and the perineum while guiding the woman to breathe instead of pushing, and preferably let the head be born between contractions. An additional midwife should attend the final part of the second stage of labor for guidance and evaluation between colleagues. There was no preferred manner of supporting the perineum, using either flat hand, curved hand with bended fingers or modified Ritgen's maneuver (Finnish maneuver). No restrictions were put on birth position in the final stage of pushing. The birth attendants could decide whether to use episiotomy or not, but only on indication, and were encouraged to only use it moderately. Mediolateral incision starting close to midpoint with an angle > 45° was the recommended method. If OASIS occurred, the midwife or obstetrician had a reflective meeting with one of the experts, and filled in data on the delivery in a separate OASIS registration form (attached as supplementary).

One yearly theoretical and practical training course for all midwives and obstetricians was arranged the following years to maintain skills. The local multidisciplinary expert group continued to have regular evaluation meetings about the incidence of OASIS, and to report to the staff. Written information about the preventive interventions, including pictures of supportive techniques was available for the staff.

All data for this study was obtained from the hospitaĺs obstetrical database and from the OASIS registration forms. The main outcome was OASIS. OASIS was categorized into degree 3A where < 50% of external sphincter muscle is torn, 3B where > 50% of the external sphincter muscle is torn, 3C where both external and internal sphincter are torn, and degree 4 which is a third degree tear with disruption of the anal epithelium as well [13].

Gestational age was determined by a second trimester ultrasound scan (eSnurra)[14] Duration of active first stage of labor, was defined as time from 4 cm to 10 cm cervical dilatation, and expulsive phase as time of active pushing. Instrumental delivery included both vacuum and forceps due to little use of forceps compared to vacuum during the study period, 0.7% versus 9.0% [11]. Lying and half-sitting (semi-recumbent) birth positions without stirrups were grouped together, as were lithotomy and semi-recumbent positions with stirrups. Additional birth positions registered were lateral, kneeling, water birth and all other positions.

The study was considered a quality assurance study by Regional Committees for Medical and Health Research Ethics (2017/2350) and approved by the Data Protection Official for Research, NSD (Norwegian Centre for Research Data) with project number 57890.

Statistical analyses

For categorical variables, we used chi square test with linear-by-linear association trend test to compare proportions according to degree of OASIS. For continuous variables, we used one-way analysis of variance (ANOVA) with Bonferroni correction. To examine the associations between potential risk factors and OASIS, we included parity, maternal age, augmentation with oxytocin, epidural analgesia, episiotomy, fetal head circumference, occiput posterior position at delivery, duration of expulsive phase and birth position in multivariable logistic regression analyses. The analysis was stratified into spontaneous deliveries and instrumental vaginal deliveries due to considerable differences in incidence of OASIS between these two modes of delivery. Data were analyzed with the statistical software package SPSS statistics version 25.0 (IBM SPSS, Armonk, NY, USA) and p-values < 0.05 were considered statistically significant.

Results

The frequency of OASIS was 3.6% in the period before interventions to prevent OASIS were introduced (2007–2010), and decreased after the implementation in 2011. During the study period from 2012 to 2017, the overall incidence of OASIS was stable at around 2.1% (Fig. 1). Demographic and obstetric characteristics of the study population according to spontaneous and instrumental deliveries are presented in Table 1. The frequency of OASIS was significantly higher in instrumental vaginal deliveries compared to spontaneous deliveries, with an average of 6.5% (136/2100) vs. 1.5% (241/16158), respectively ($p < 0.01$) (Table 1). Linear-by-linear analyses showed a significant trend of lower OASIS incidence among spontaneous deliveries, falling from 2.1% to 1.2% during the study period ($p = 0.01$) (Fig. 2). No significant trend was observed for instrumental deliveries, where the incidence fluctuated between 4.0% and 9.3% ($p = 0.37$) (Fig. 2).

Primiparity was highly associated with more OASIS in both spontaneous and instrumental deliveries with an adjusted OR of 3.4 (95% CI 2.4–4.9; Table 2) and 2.6 (95% CI 1.5–4.7; Table 3), respectively, Maternal age, epidural analgesia and fetal head circumference were associated with OASIS in spontaneous deliveries (Table 2), while occiput posterior position and fetal head circumference were associated with OASIS in instrumental deliveries (Table 3). Episiotomy was associated with fewer OASIS in instrumental deliveries with an adjusted OR of 0.4 (95% CI 0.3–0.6; Table 3). The incidence of OASIS was higher in women with a spontaneous delivery in lithotomy or semi-recumbent birthing position using stirrups (2.2%), compared to women giving birth in other positions without stirrups grouped together (1.3%) ($p < 0.01$). However, this association was not statistically significant after adjustment (Table 2).

Characteristics of women with OASIS according to rupture grade are presented in Table 4. Women originating from sub-Saharan Africa constituted 13% of women with OASIS grade 4, but only 5% of women

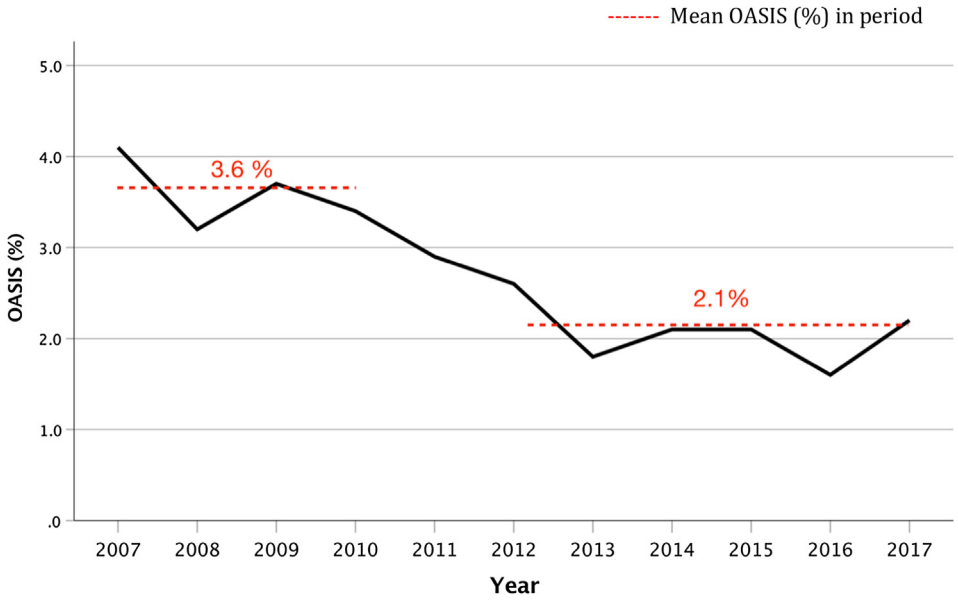

Fig. 1. Frequency of OASIS in all vaginal deliveries before and after implementation of interventions in mid-2011, data from local obstetric database.

Table 1
Maternal, obstetric and fetal characteristics of the study population according to delivery method. Women with vaginal birth, a single fetus in cephalic presentation after 37 full weeks of gestation (n = 18258).

	Spontaneous (n = 16158) % or mean (SD)	Instrumental[a] (n = 2100) % or mean (SD)
Maternal characteristics		
Primiparity	41.2	79.6
Maternal age, years, mean (SD)	30.1 (5.0)	29.7 (5.0)
Gestational age, days, mean (SD)	281 (8.0)	283 (8.2)
Origin[b]		
Norwegian	84.3	82.1
Western (outside Norway)	4.7	4.5
Non-Western	11.0	13.3
Obstetric characteristics		
Induction of labor	18.7	28.6
Oxytocin augmentation[c]	21.1	78.5
Epidural analgesia	30.1	66.8
Duration active first stage, minutes (n = 18207)	267 (217)	484 (260)
Duration expulsive phase, minutes (n = 17845)	27 (23)	53 (30)
Birth position		
Lithotomy or semi-recumbent with stirrups	16.9	98.0
Lying or semi-recumbent	60.2	2.0
Lateral	7.9	–
Kneeling	3.7	–
Waterbirth	10.3	–
Other	1.0	0.0
Episiotomy	6.5	51.1
OASIS (grade 3 or 4)	1.5	6.5
Bleeding, ml	369 (269)	446 (292)
Shoulder dystocia	0.5	2.0
Fetal characteristics		
Birth weight, grams (n = 15993)	3581 (461)	3588 (481)
Birth weight > 4500 g	2.7	3.3
Head circumference, cm (n = 15,894)	35.2 (1.5)	35.7 (1.7)
Occiput posterior position	3.5	9.8
Apgar score 5 min < 7	0.6	4.6
pH in umbilical artery < 7.0 (n = 13,333)	0.3	1.1

[a] Vacuum and forceps together.
[b] Origin according to the hospital's obstetrical database.
[c] Used during active first stage and/or expulsive phase.

with OASIS overall (not presented in table). Among these women, 77% (13/19) had experienced female genital mutilation (FGM). In women with instrumental deliveries, 11% with rupture grade 4 had episiotomy compared to 39%-48% for the other rupture grades. Fewer contractions were used for the vacuum extraction and more oxytocin augmentation was used for grade 4 ruptures than the other rupture grades in both spontaneous and instrumental deliveries. The results showed little difference in years of experience of birth attendants across rupture grades. In approximately 70% of deliveries, the woman breathed instead of pushing in the last contraction. More rarely, the head was born between contractions.

When examining trends across the study period, the frequency of primiparous women was lowest in 2014 (43.4%) and highest in 2017 (49.5%) with an increasing trend ($p < 0.01$). The use of epidural analgesia increased from 28.3% in 2012 to 38.3% in 2017 ($p < 0.01$), and the use of episiotomy increased from 9.9% overall in 2012 to 13.3% in 2017 ($p < 0.01$). The frequency of instrumental deliveries varied from 10.7% to 12.1% during the study period, but no trend was observed ($p = 0.64$). The frequency of oxytocin augmentation was lowest in 2012 (23.4%) and highest in 2013 (32.3%) and thereafter decreasing to around 27% ($p = 0.73$). The frequency of occiput posterior position at delivery was stable around 4.2%. Mean maternal age was 29.8 years in 2013 and 30.3 years in 2016. The mean duration of the expulsive phase varied only between 29 and 30 min, and mean head circumference varied between 35.4 and 35.3 cm.

Discussion

The main finding was that an overall decrease of OASIS observed after preventive interventions were introduced sustained the subsequent six years. There was a trend towards lower risk of OASIS for spontaneous deliveries throughout the study period, suggesting a continuous improvement. However, no such trend was observed for instrumental deliveries, and the frequency was markedly higher than in spontaneous deliveries.

The study may suggest that training in practical skills and a brush-up of the available evidence each year may be effective to maintain a relatively low level of OASIS. The decreasing trend for spontaneous deliveries across the period may indicate a high focus among midwives on avoiding OASIS, since they are the ones who handle these deliveries.

The observed higher risk of OASIS in instrumental than spontaneous deliveries is in accordance with other studies [5,15,16]. Therefore the

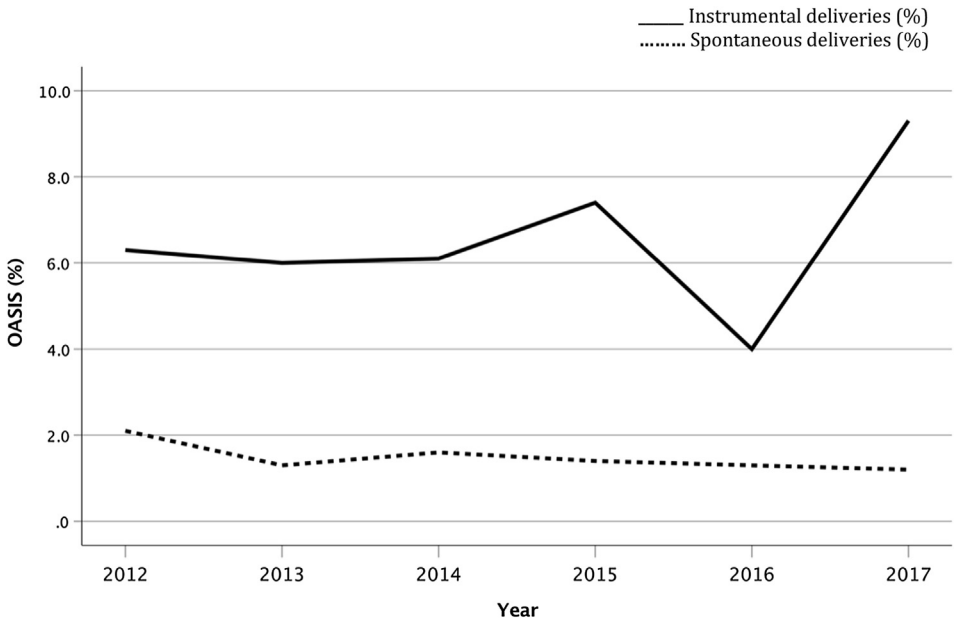

Fig. 2. Trend of OASIS in spontaneous (————) and instrumental (____) deliveries of a single fetus in cephalic presentation after 37 full weeks of gestation during study period 2012–2017.

regression analyses were stratified into spontaneous and instrumental deliveries, which revealed varying importance of risk factors for the two groups. The use of forceps compared to vacuum is associated with higher frequency of OASIS [4,11] and more severe OASIS [16]. There were more OASIS when using forceps than vacuum in the study, but because forceps are far less used in this department, all instrumental deliveries were examined as one group. Other Norwegian hospitals have lowered the risk of OASIS in instrumental deliveries after introducing intervention programs [9]. This study showed an overall decrease in OASIS within instrumental deliveries between the four years before the study period and after the intervention, however there was no trend towards fewer OASIS during the study period. This necessitates increased focus on preventing OASIS when vacuum or forceps are used in this department.

Primiparity has been associated with an increased risk of OASIS [4,17], which is in accordance with the findings in both spontaneous and instrumental deliveries in this study. A trend towards more primiparas was observed during the study period. Also increasing age was associated with higher risk of OASIS, which is in line with other studies [4,18], and a trend towards higher age has also been observed [18].

The use of episiotomy has been suggested to both protect against OASIS and to increase the risk of OASIS [19,20]. Increased risk has been found for spontaneous deliveries in primiparas [5] and multiparas [4,5], and decreased risk when used in instrumental deliveries in primiparas [4,5,15] and multiparas [5]. The present study showed no significant association between the use of episiotomy and OASIS in spontaneous deliveries, but episiotomy was associated with a significant lower frequency of OASIS in instrumental deliveries. Indications for episiotomy and risk factors for OASIS are associated, thus study results should be interpreted with caution [21]. There is also considerable variation in the performance of episiotomy, despite guidelines, resulting in an angle closer to the midline than intended [22], which may influence a potential protective effect. The present data were inadequate to investigate these issues further.

Increased birth weight and head circumference are both associated with OASIS [3,4,20,23]. Increased head circumference was significantly associated with OASIS in both spontaneous and instrumental deliveries, and also more important than birth weight in this study; thus we chose to include head circumference in the multiple regression analyses. Also occiput posterior position has been associated with OASIS [24], as observed in the present study, but only in instrumental deliveries. The frequencies of these variables were stable throughout the study period, though, implying that an effect on trend in OASIS was not likely.

A prolonged second stage of labor has been suggested as an

Table 2
Risk factors associated to obstetric anal sphincter injuries (OASIS) in spontaneous births (n = 16158).

	Crude analyses			Multiple regression analyses		
	OR	95% CI	p-value	a OR	95% CI	p-value
Primiparity	3.22	2.44–4.23	< 0.01	3.44	2.43–4.87	< 0.01
Maternal age	1.00	0.97–1.02	0.78	1.03	1.00–1.06	0.03
Oxytocin augmentation[a]	1.60	1.21–2.12	< 0.01	1.17	0.82–1.68	0.34
Epidural analgesia	1.03	0.78–1.36	0.83	0.72	0.52–1.00	0.05
Duration expulsive phase	1.01	1.01–1.02	< 0.01	1.00	1.00–1.01	0.74
Episiotomy	1.23	0.77–1.98	0.39	0.69	0.41–1.17	0.17
Occiput posterior position	1.06	0.54–2.08	0.86	1.28	0.65–2.53	0.48
Child head circumference	1.11	1.02–1.21	0.01	1.16	1.07–1.27	< 0.01
Lithotomy or semi-recumbent position with stirrups[b]	1.68	1.25–2.25	< 0.01	1.28	0.91–1.80	0.16

OR: odds ratio; CI: confidence interval.
[a] Used in active first stage and/or expulsive phase.
[b] Birth position.

Table 3
Risk factors associated to obstetric anal sphincter injuries (OASIS) in instrumental births (n = 2100).

	Crude analyses			Multiple regression analyses		
	OR	95% CI	p-value	a OR	95% CI	p-value
Primiparity	1.52	0.94–2.48	0.09	2.64	1.49–4.67	< 0.01
Maternal age	1.03	1.00–1.07	0.06	1.04	1.00–1.08	0.07
Oxytocin augmentation[a]	1.12	0.72–1.72	0.62	1.06	0.64–1.74	0.83
Epidural analgesia	0.85	0.59–1.21	0.36	0.87	0.58–1.30	0.50
Duration expulsive phase	1.00	0.99–1.00	0.58	1.00	0.99–1.00	0.30
Episiotomy	0.48	0.34–0.69	< 0.01	0.40	0.27–0.59	< 0.01
Occiput posterior position	1.66	1.01–2.73	0.05	2.07	1.20–3.57	0.01
Child head circumference	1.11	0.99–1.24	0.07	1.15	1.03–1.29	0.01

OR: odds ratio; CI: confidence interval.
[a] Used during active first stage and/or expulsive phase.

individual risk factor for OASIS [20,23]. No association between a longer expulsive phase and OASIS was found. Oxytocin augmentation may be associated with OASIS, but this is challenging to investigate because of the complex interactions between duration of second stage, epidural analgesia and instrumental delivery [15]. The multiple regression analysis showed no association between oxytocin augmentation and OASIS in instrumental deliveries. Neither the duration of expulsive phase, nor the use of oxytocin augmentation changed significantly during the study period.

Increased risk of OASIS has been observed in Asian and African women [4,5,23]. In this cohort, non-Western women experienced more instrumental deliveries than Norwegian/Western women. A large proportion of countries performing female genital mutilation (FGM), which is associated with OASIS, are located in sub-Saharan Africa [25]. An increasing number of childbearing women in Norway comes from this region [4]. Women with OASIS who had gone through FGM seemed to have more severe OASIS in this study, but the number of cases was small. Both FGM and communication problems may contribute to more OASIS among these women [4].

Most Norwegian birth departments recommended perineal support in 2011, but 40% of these practiced a free choice of technique [26]. A Cochrane review from 2011 and updated in 2017, suggested some effect on reducing OASIS by using warm compresses and perineal massage, but found insufficient data to show whether other perineal techniques had effect [27]. However, this review only included randomized controlled trials, and not observational intervention studies, like those using the “Finnish maneuver” [8,9]. Perineal protection is difficult to evaluate in retrospective studies since it is not documented in patient records or birth registries [6]. No randomized controlled trial has been performed on the preventive program, and it is not clear which part of the interventions that has resulted in the decreased number of incidents of OASIS, whether it was the particular technique in supporting perineum, breathing the head out etc., or a combination of all factors [22,28]. Recent studies have examined evidence behind interventions, and a more thorough analysis of effect and side effects, e.g. increased episiotomy rate, has been recommended before implementation [10]. The interventions in the studied department included optional technique for perineum support and optional birth position in the very end, as suggested in a Cochrane review on birth positions and OASIS [29], and more restrictive use of episiotomy than the “Finnish intervention” has resulted in. The reduced frequency of OASIS in this study may indicate that there are several possible approaches to improve quality regarding OASIS, but the results also revealed that further improvements are needed for instrumental deliveries.

The strengths of this study are the size of the cohort and the length of the study period. The local obstetrical database was used to validate data from the OASIS registration forms. The detailed data from these forms may provide additional information to future local procedures to decrease OASIS.

The main limitation is the retrospective design; hence any causation between interventions and OASIS could not be examined. Nor could any associations between the preventive interventions and OASIS be examined, since this information only existed for women with OASIS. The registration forms contained many missing data, especially for instrumental deliveries. A future study should register which preventive interventions that are used in all deliveries, not only if OASIS occurs

All risk factors were mutually adjusted in the multiple regression analyses of OASIS. This might involve a risk of over-adjustment, especially when examining the association between oxytocin augmentation and OASIS while adjusting for duration of expulsive phase. The analyses were replicated without adjusting for duration of expulsive phase, but still no significant association between oxytocin augmentation and

Table 4
Characteristics of women with obstetric anal sphincter injuries (OASIS) according to mode of delivery and rupture grade (n = 377).

		Spontaneous delivery n (%) or mean (SD)				Instrumental delivery n (%) or mean (SD)				
	Total n = 241	3A n = 103	3B n = 72	3C n = 45	4 n = 21	Total n = 136	3A n = 62	3B n = 50	3C n = 15	4 n = 9
Primiparous	164 (68)	64 (62)	56 (78)	30 (67)	14 (67)	114 (84)	52 (84)	43 (86)	11 (73)	8 (89)
FGM	8 (3)	2 (2)	2 (3)	3 (7)	1 (5)	5 (4)	1 (2)	1 (2)	1 (7)	2 (22)
Episiotomy	27 (11)	10 (10)	8 (11)	7 (16)	2 (10)	56 (41)	24 (39)	24 (48)	7 (47)	1 (11)
Vacuum						126 (93)	58 (94)	47 (94)	13 (87)	8 (89)
Forceps						10 (7)	4 (6)	3 (6)	2 (13)	1 (11)
Number of pulls instrumental deliveries						3.1 (1.3)	3.3 (1.7)	3.1 (1.3)	3.3 (1.7)	2.8 (0.9)
Shoulder dystocia	9 (4)	2 (2)	3 (4)	1 (2)	3 (14)	12 (9)	4 (6)	6 (12)	2 (13)	0 (0)
Oxytocin augmentation in first stage	36 (15)	13 (13)	13 (18)	6 (13)	4 (19)	59 (43)	26 (42)	23 (46)	5 (33)	5 (56)
Oxytocin augmentation in second stage	63 (26)	23 (22)	24 (33)	10 (22)	6 (29)	101 (74)	46 (74)	37 (74)	11 (73)	7 (78)
Birth attendant’s experience (years)	7.7 (6.2)	8.4 (6.8)	6.9 (5.4)	8.2 (6.3)	5.7 (5.8)	8.2 (7.9)	7.4 (7.1)	7.8 (7.1)	12.7 (11.1)	7.3 (10.1)
Communication problems	17 (7)	8 (8)	3 (4)	4 (9)	2 (10)	14 (10)	7 (11)	2 (4)	2 (13)	3 (33)

FGM: female genital mutilation.

OASIS was found.

In conclusion, the rates of OASIS maintained at a steady level of around 2.1% during the six following years after introduction of preventive interventions. Regularly theoretical and practical repetition seemed to be important in order to maintain a low level. Changing trends in associated risk factors had probably no important implications.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.srhc.2019.100460.

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