**Improvements in obstetric care: analysis of 18 years of real-world data on the reduction of obstetric anal sphincter injuries during instrumental deliveries**

Kathrine Fodstada, Katariina Laineb, c, Sari Räisänend

a Department of Obstetrics and Gynecology, Bærum Hospital, Vestre Viken Hospital Trust, Norway

b Norwegian Research Centre for Women’s Health, Oslo University Hospital, Oslo, Norway

c Institute of Clinical Medicine, Faculty of Medicine, University of Oslo, Oslo, Norway

d Laurea University of Applied Sciences, Digital Degrees and Master’s Degrees, Vantaa, Finland

**Corresponding author**:

Kathrine Fodstad

Department of Obstetrics and Gynecology, Bærum Hospital, Vestre Viken Hospital Trust, Pb 800, 3004 Drammen, Norway

Business telephone number: +47-67 80 94 00

Home telephone number: +47-911 37 661

E-mail: kathrif@gmail.com

kfodstad@vestreviken.no

**Abstract**

**Objective** To determine the prevalence and secular trends of obstetric anal sphincter injuries (OASIS) in vacuum and forceps deliveries in Norway, both with and without episiotomy.

**Design** Population-basedprospective real-world datacollected during 2001‒2018.

**Setting** Medical Birth Registry Norway.

**Population or Sample** Nulliparous women with singleton fetuses in a cephalic presentation delivered by either vacuum or forceps (n=70,783).

**Methods** Logistic regression analyses were applied to the OASIS prevalence in six 3-year time periods. Both crude odds ratios and adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were determined.

**Main Outcome Measures** OASIS prevalence.

**Results** The OASIS prevalence in vacuum and forceps deliveries decreased from 14.8% during 2001–2003 to 5.2% during 2016–2018. The overall reduction between the first and last 3-year time period was 61% (aOR=0.39, 95% CI=0.35–0.43). The only exception to this decreasing trend in OASIS was found in forceps deliveries performed without an episiotomy. The OASIS prevalence was approximately twofold higher in forceps compared to vacuum deliveries (aOR=1.92, 95% CI=1.79–2.05). Performing either a mediolateral or lateral episiotomy was associated with a 45% decrease in the prevalence of OASIS relative to no episiotomy (aOR=0.55, 95% CI=0.52–0.58).

**Conclusions** Opting for vacuum rather than forceps delivery in conjunction with a mediolateral or lateral episiotomy could significantly lower the OASIS prevalence in primiparous women.

**Funding** The Norwegian SIDS and Stillbirth Society.

**Keywords** Vacuum delivery, forceps delivery, nulliparous, episiotomy, obstetric anal sphincter injury, third- and fourth-degree perineal lacerations.

# Funding

# The Norwegian SIDS and Stillbirth Society provided financial support (grant number 554.04/14) to retrieve data files from the registries. The awarded grant did not include external peer review for scientific quality or priority assessment, and the funder did not play any role in conducting research and writing the paper.

# Introduction

Obstetric anal sphincter injuries (OASIS), also known as third- and fourth-degree perineal lacerations, are dreaded complications of vaginal birth. Both long- and short-term sequelae can occur even when such injuries are surgically repaired immediately after giving birth. It has been reported that 30‒70% of women who experience OASIS during vaginal delivery suffer from anal incontinence (1,2). Women with OASIS also report dyspareunia, perineal pain, posttraumatic stress disorder, and reduced quality of life (3–6).

Operative vaginal delivery is one of the most important risk factors for OASIS (7–9). Previous studies have found that the OASIS prevalence is higher in forceps deliveries than in vacuum deliveries (7–9), but most of these studies used spontaneous vaginal birth as the reference when assessing the OASIS risk in vacuum and forceps deliveries. Such a study design compares noncomparable patient groups, since the risk profile of women needing instrumental assistance during the second stage of labor differs from that of women not needing such a shortening of the second stage. Analyzing the OASIS risk by comparing vacuum and forceps deliveries has rarely been done in population-based studies using real-world data (10).

Norwegian midwives and doctors have managed to significantly reduce the prevalence of OASIS in vaginal deliveries following the introduction of a national care bundle in 2005 (11–15). This care bundle focuses on manual perineal protection, episiotomy based on indication only, and careful communication with the delivering woman, instructing her to not push during the last phase when crowning of the fetal head occurs. The OASIS prevalence decreased from approximately 4.2% in 2004 to 2.3% in 2010 (13), and further to 1.6% in 2023, calculated as a proportion of all vaginal deliveries (16).

There is strong evidence that mediolateral and lateral episiotomy techniques are protective against the OASIS risk in both vacuum and forceps deliveries (17–19), while median episiotomy has been shown to increase the OASIS risk (20,21). Data from 24 OECD (Economic Cooperation and Development) countries showed that greater use of episiotomy was associated with a lower OASIS prevalence (22).

The main aim of the present study was to compare the OASIS risk between forceps and vacuum deliveries and identify the role of episiotomy in preventing OASIS. We also explored the secular trends of OASIS during implementation of the national care bundle aimed at reducing the OASIS prevalence.

**Methods**

This study formed part of The PURPLE Study exploring pregnancy and delivery complications in Norway during based on data from Medical Birth registry of Norway (MBRN). The present study analyzed prospective 18-year real-world data from the Medical Birth Registry of Norway collected during 2001‒2018. The study design was evaluated and approved by the regional ethical committee (2015/681, renewed in 2017, 2019, and 2020) and the institutional Personal Data Officer at Oslo University Hospital (Oslo, Norway). All parts of the study followed Norwegian Health Research legislation. The data were pseudonymized by the MBRN and contact between researchers and study participants was neither necessary nor possible. The MBRN is a compulsory quality registry that records all births (including home births) in Norway. There are no private hospitals managing childbirths in Norway, with maternity hospitals being publicly funded. Antenatal care is standardized and free of charge for all residents of Norway.

Information on the maternal pre-pregnancy health status, reproductive history, follow-up visits, and complications during pregnancy are prospectively recorded on a standardized pregnancy health card during antenatal health-care appointments similarly throughout the country. Interventions during labor and delivery, and the health and condition of the newborn are recorded during and immediately after birth by the attending midwife and doctor, and a mandatory notification is sent to the MBRN. The information is digitally transferred to the MBRN immediately after birth. The health statuses of the mother and newborn postpartum are recorded and registered at the MBRN during the hospital stay, including based on observations made by the pediatrician and perinatologist. The MBRN validates the data against other health registries, the population registry, and the death registry.

Nulliparous women who needed an assisted vaginal delivery (using either vacuum or forceps) with singleton fetuses in a cephalic presentation (n=70,783) were included in the study population. Deliveries where both vacuum and forceps were used (n=511, 0.7% of 70,783) were included in the forceps group. Spontaneous deliveries, caesarean sections, multiple pregnancies, breech deliveries, and pregnancies at a gestational age before 22 weeks were excluded.

The outcome variable was an obstetric anal sphincter injury, defined as a tear either in the external anal sphincter muscle or in both the internal and external muscles. Tears of degree 3A, 3B, 3C, and 4 were merged into one variable (OASIS) in the MBRN. To study the secular trends of OASIS, the study period (2001‒2018) was categorized into six 3-year time periods, with the first time period being 2001‒2003 and the last being 2016‒2018. The first time period was used as the reference in the analyses.

OASIS risk factors included in the statistical analyses as confounders were identified based on previous literature. Birthweight in grams was categorized into four groups: <3000, 3000‒3499 (reference), 3500‒3999, and ≥4000. Maternal age in years was categorized into five groups: <25, 25‒29 (reference), 30‒34, 35‒39, and ≥40. Fetal presentation was categorized into normal cephalic and abnormal cephalic presentation. Gestational age was categorized into <34, 34‒36+6, and ≥37 weeks. Episiotomy and epidural analgesia were categorized into yes and no. In Norway it is recommended that episiotomy be applied based only on indication, with either the lateral or mediolateral type of episiotomy being used.

*Statistical analyses*

The OASIS prevalence was calculated according to six time periods during 2001‒2018, mode of delivery (vacuum or forceps), and maternal and fetal demographic and obstetric factors. Logistic regression analyses using the backward elimination method were applied to determine the associations between OASIS risk factors as well as between episiotomy and OASIS. The crude odds ratios for all variables were defined. Adjusted odds ratios (aORs) were calculated for two models at a 95% significance level: model 1 was adjusted for mode of delivery, time periods, epidural analgesia, birthweight, fetal head presentation, and maternal age; while model 2 added episiotomy use to model 1 in order to study the effect of episiotomy on OASIS prevalence. SPSS software (version 26, IBM) was used to perform the analyses.

*Missing data*

The newborn birthweight was missing in 0.03% (n=25) deliveries, and these were excluded from the regression analyses.

**Results**

*Study population*

The study population consisted of 70,783 nulliparous women, comprising 86.1% (n=60,962) deliveries with vacuum assistance and 13.9% (n=9,821) using forceps (Table 1).

*Comparing vacuum and forceps deliveries*

Maternal and fetal demographics and obstetric factors according to delivery mode (vacuum or forceps) are presented in Table 1. The use of forceps was more common (4.9%) than vacuum (2.3%) in preterm deliveries, and in an abnormal cephalic presentation (11.0% vs 9.2%, respectively) (Table 1).

*OASIS prevalence*

During the study period, the overall OASIS prevalence was 8.6% (6 099 of 70 783) and higher in forceps (12,8%, 1256 of 9 821) compared to vacuum deliveries (7,9% 4843 of 60 962) (Table 1).

The OASIS prevalence decreased gradually in every time period during the entire study period, from 14.8% (in 2001‒2003) to 5.2% (in 2016‒2018).

*OASIS and episiotomy*

Episiotomy was performed in 69.1% (n=42,139) of the 60,962 vacuum deliveries and in 84.7% (n=8,318) of the 9,821 forceps deliveries (Table 1). In deliveries assisted by vacuum extraction, use of episiotomy was associated with a 49% (95% CI 46‒52%) decreased OASIS prevalence compared with deliveries without episiotomy (Table 2). In deliveries assisted with forceps, episiotomy use was associated with a 51% (95% CI 43‒57%) decreased OASIS prevalence compared with deliveries without episiotomy (Table 2).

In all birthweight categories and fetal head presentations, episiotomy use was associated with a 30‒53% reduction in OASIS prevalence in vacuum extractions, and a 31‒52% decrease in forceps deliveries (Table 2).

Figure 1 illustrates the OASIS prevalence by 3 year time periods, categorized into 4 delivery subgroups; forceps deliveries and vacuum extractions, both with and without episiotomy. The OASIS prevalence decreased by 41-71% in three of the four delivery subgroups. However, in forceps deliveries without episiotomy, no reduction was observed over time.

*Logistic regression analyses*

The prevalence of OASIS was approximately twofold higher in forceps than vacuum deliveries (aOR=1.92, 95% CI=1.79‒2.05) after adjusting for episiotomy use, time period, epidural analgesia, birthweight, fetal head presentation, and maternal age (Table 3, model 2).

Crude analyses showed that episiotomy use was associated with a 46% reduction (OR 0.54, 95% CI=0.52‒0.57) in the OASIS prevalence. After adjusting for time period, epidural analgesia, birthweight, presentation, and maternal age the results remained almost the same (aOR=0.55, 95% CI=0.52‒0.58) (Table 3, model 2).

The OASIS prevalence decreased by 61% (aOR=0.39, 95% CI=0.35‒0.43) from the first time period (2001–2003) to the last (2016–2018) after adjusting for episiotomy use, time period, epidural analgesia, birthweight, fetal head presentation, and maternal age (Table 3, model 2).

Receiving epidural analgesia during labor was associated with a 19% reduction in the prevalence of OASIS (aOR=81, 95% CI=0.77‒0.85) relative to deliveries without epidural analgesia (Table 3, model 2). The prevalence of OASIS doubled (aOR=1.98, 95% CI=1.84–2.14) when the birthweight was ≥4000 grams and was 65% higher in an abnormal fetal head presentation (aOR=1.65, 95% CI=1.52‒1.79) than in a normal cephalic presentation (Table 3, model 2). The OASIS prevalence was 20% lower (aOR=0.80, 95% CI=0.74‒0.86) in women who gave birth at the age of <25 years than in those giving birth at the age of 25‒29 years. For all other age groups (≥30 years) the differences were not significant (Table 3, model 2).

**Discussion**

*Main findings*

To the best of our knowledge, the present study is one of the few to have compared the OASIS risk in forceps delivery relative to vacuum delivery utilizing a large database of prospectively collected population-based real-world data (10). Overall, the prevalence of OASIS was twofold higher in forceps deliveries than in vacuum deliveries.

The OASIS prevalence decreased by 61% during the 18-year long study period, from 14.8% in 2001‒2003 to 5.2% in 2016‒2018. Episiotomy in instrumental deliveries was associated with a 45% reduction in the prevalence of OASIS relative to deliveries without episiotomy. The OASIS prevalence was also reduced in vacuum deliveries without episiotomy, indicating a change in Norwegian labor management during the study period. Still, such a reduction was not observed in forceps deliveries without episiotomy.

Only minor differences were observed concerning maternal and fetal characteristics comparing forceps to vacuum deliveries. In cases of preterm birth (<37 weeks), forceps delivery (4.9%) was favored over vacuum delivery (2.3%), and episiotomy was performed more often in forceps compared to vacuum deliveries (84.7% vs. 69.1%, respectively).

*Strengths and limitations*

The main strength of this study was the utilization of an18-year long and prospectively collected population, based on real-world data. Our data source incorporates all deliveries in Norway, thereby minimizing selection bias. Compared to randomized controlled trials with strict inclusion criteria, our results are probably more generalizable because they are based on a national population of nulliparous women, all in need of instrumental assistance during the second stage of labor. Studies comparing OASIS risk in spontaneous and operative vaginal deliveries, in reality compare normal physiological to complicated deliveries. Hence, comparison is done between different patient groups with different risk profiles. This is problematic since the OASIS risk in spontaneous vaginal delivery is not comparable to that in instrumental vaginal delivery.

In our study design, all primiparous women included needed an instrumental delivery, and we were therefore able to assess the effect of the chosen instrument. The risk of confounding by indication in our study was probably low, due to the maternal and fetal characteristics being very similar across the groups, with the exception of preterm deliveries.

The main limitation of this study is that register based data is prone to inaccuracies and errors. However, the analyzed data had been validated previously and the amount of missing information was notably low (23,24). Another limitation is that manual perineal protection is not recorded in the MBRN, and so we could only report that a national care bundle that included manual perineal protection, was implemented during the study period.

*Interpretation*

An increasing trend in OASIS has been reported for both spontaneous and operative vaginal deliveries from 1967 to 2002 in Norway (7). This worrying trend prompted a national care bundle to be launched with the aim of reducing morbidity related to perineal injuries during vaginal births. The national care bundle included education on improving OASIS detection and repair, a comprehensive training program for midwives and obstetricians on techniques to decelerate the delivery of the fetus’s head, communication between the birth attendant and the delivering woman so as to avoid pushing during crowning of the fetal head, and manual perineal protection during the last phase of the second stage of labor, with the overall aim to reduce perineal injuries. Recommendations were to perform episiotomy by indication only, applying either the lateral or mediolateral technique (11,13–15,25). The national care bundle was launched in 2005 and progressively implemented in Norwegian maternity units. A notable reduction in the overall OASIS prevalence has been found in various studies (11–15) and in the MBRN (16).

The decrease in OASIS prevalence during operative vaginal deliveries aligns with previous research comparing OASIS trends in other countries (26–28). Gyhagen et al. (26) reported a notable decrease in OASIS prevalence in both spontaneous and instrumental deliveries in Norway from 2004 to 2016, contrasting with increases or only marginal decreases in Sweden, Canada, and Austria. By 2016 Norway had achieved the lowest OASIS prevalence among these four countries. The authors attributed the decreasing OASIS prevalence to the implementation of the national care bundle aimed at reducing perineal injuries during the second stage of labor. Rasmussen et al. described the positive effect of manual perineal protection on reducing the OASIS prevalence in Denmark (27). Implementation of a national care bundle to reduce OASIS prevalence in the UK has also resulted in a reducing trend (28).

A systematic review and meta-analysis by Lund et al. found that that the OASIS risk was reduced by approximately 50% when mediolateral or lateral episiotomy was used in vacuum deliveries in nulliparous women (17). This concurs with our result that episiotomy decreased the OASIS prevalence by 45% in both vacuum and forceps deliveries.

We performed stepwise logistic regression analyses to investigate the effects of episiotomy on secular trends of OASIS. Models 1 and 2 were used to determine aORs for OASIS in six 3-year time periods. Model 2 shows that adding episiotomy to model 1 resulted in the prevalence of OASIS either increasing or remaining unchanged, suggesting that episiotomy did not explain the decreasing OASIS prevalence observed in our study. This result is consistent with the national care bundle having the positive effect of decreasing the OASIS prevalence. The reduced OASIS prevalence also in vacuum deliveries without episiotomy (Figure 1) indicates the strong effect of manual perineal protection even in complicated deliveries when vacuum assistance is needed. However, using forceps is probably more traumatic for the delivering woman’s perineum, hence, the OASIS prevalence without episiotomy remains high.

The type of episiotomy performed (midline, mediolateral, or lateral) as well as the correct execution of the mediolateral or lateral technique have been shown to be crucial in reducing the risk of OASIS (21,29,30).

**Conclusions**

This 18-year long population-based study suggests that the OASIS prevalence in nulliparous women during instrumental deliveries is more likely to be reduced when using vacuum assistance coupled with either mediolateral or lateral episiotomy, relative to using forceps.

Our findings also suggest that the Norwegian national care bundle has been successful in decreasing the OASIS prevalence. The reduced OASIS prevalence in vacuum deliveries without episiotomy, indicate that the introduction of manual perineal protection made a notable contribution to this improvement, since the use of episiotomy alone did not explain the results. Implementing strategies such as manual perineal protection, performing episiotomies only when indicated, and effective communication with patients—specifically instructing them to not push during crowning of the fetal head—are all essential in order to further decrease the OASIS prevalence.

**Acknowledgements**

Funding for Online Open publication was provided by Vestre Viken Hospital Trust, Norway.

**Disclosure of Interests**

K.F.: none

K.L.: none

S.R.: none

**Contribution to Authorship**

K.F., K.L., and S.R. planned the study.

K.L. collected the data and carried out the analyses.

K.F., K.L., and S.R. interpreted the data, drafted and reviewed the manuscript, and approved the submitted version.

**Details of Ethics Approval**

The study was approved by the Regional Committee for Medical Research Ethics in South East Norway on March 24, 2015 (approval number 2015/681; renewed in 2017, 2019, and 2020), and by the Institutional Personal Data Officer in Oslo University Hospital. Only pseudonymized data were analyzed.

**Funding**

The Norwegian SIDS and Stillbirth Society provided financial support (grant number 554.04/14) to retrieve data files from the registries. Vestre Viken Hospital Trust, Norway provided funding for Online Open publication.

**References**

1. Nilsson IEK, Åkervall S, Molin M, Milsom I, Gyhagen M. Symptoms of fecal incontinence two decades after no, one, or two obstetrical anal sphincter injuries. Am J Obstet Gynecol. 2021 Mar;224(3):276.e1–23.

2. Gommesen D, Nohr EA, Qvist N, Rasch V. Obstetric perineal ruptures—risk of anal incontinence among primiparous women 12 months postpartum: a prospective cohort study. Am J Obstet Gynecol. 2020;222(2):165.e1–11.

3. Fodstad K, Staff AC, Laine K. Sexual activity and dyspareunia the first year postpartum in relation to degree of perineal trauma. Int Urogynecol J. 2016;27(10):1513–3.

4. Lindqvist M, Persson M, Nilsson M, Uustal E, Lindberg I. ‘A worse nightmare than expected’ - a Swedish qualitative study of women’s experiences two months after obstetric anal sphincter muscle injury. Midwifery. 2018 Jun;61:22–8.

5. Baumann S, Staudt A, Horesh D, Eberhard-Gran M, Garthus-Niegel S, Horsch A. Perineal tear and childbirth-related posttraumatic stress: a prospective cohort study. Acta Psychiatr Scand. 2023 Aug 7;1–12.

6. Rebmann E, Hamel JF, Helbert C, Lemasson F, Legendre G, Venara A. Anal incontinence after obstetrical anal sphincter injury significantly impacts quality of life for women: a cohort study. Langenbecks Arch Surg. 2024 Feb 17;409(1):67.

7. Baghestan E, Irgens LM, Børdahl PE, Rasmussen S. Trends in risk factors for obstetric anal sphincter injuries in Norway. Obstet Gynecol. 2010 Jul;116(1):25–34.

8. Verma GL, Spalding JJ, Wilkinson MD, Hofmeyr GJ, Vannevel V, O’Mahony F. Instruments for assisted vaginal birth. Cochrane Database Syst Rev. 2021 Sep 24;2021(9):CD005455.

9. Gurol-Urganci I, Cromwell DA, Edozien LC, Mahmood TA, Adams EJ, Richmond DH, et al. Third- and fourth-degree perineal tears among primiparous women in England between 2000 and 2012: time trends and risk factors. BJOG. 2013 Nov;120(12):1516–25.

10. Muraca GM, Boutin A, Razaz N, Lisonkova S, John S, Ting JY, et al. Maternal and neonatal trauma following operative vaginal delivery. CMAJ. 2022 Jan 10;194(1):E1–12.

11. Hals E, Øian P, Pirhonen T, Gissler M, Hjelle S, Nilsen EB, et al. A multicenter interventional program to reduce the incidence of anal sphincter tears. Obstet Gynecol. 2010 Oct;116(4):901–8.

12. 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 Mar;103(3):488–97.

13. Laine K, Rotvold W, Staff AC. Are obstetric anal sphincter ruptures preventable?-- Large and consistent rupture rate variations between the Nordic countries and between delivery units in Norway. Acta Obstet Gynecol Scand. 2013 Jan;92(1):94–100.

14. 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 Oct 17;2(5):e001649.

15. Laine K, Pirhonen T, Rolland R, Pirhonen J. Decreasing the incidence of anal sphincter tears during delivery. Obstet Gynecol. 2008 May;111(5):1053–7.

16. The Medical Birth Registry [Internet]. Oslo, Norway: Norwegian Institute of Public Health; Available from: http://statistikkbank.fhi.no/mfr/

17. Lund NS, Persson LKG, Jangö H, Gommesen D, Westergaard HB. Episiotomy in vacuum-assisted delivery affects the risk of obstetric anal sphincter injury: a systematic review and meta-analysis. Eur J Obstet Gynecol Reprod Biol. 2016 Dec;207:193–9.

18. Räisänen S, Vehviläinen-Julkunen K, Cartwright R, Gissler M, Heinonen S. Vacuum-assisted deliveries and the risk of obstetric anal sphincter injuries—a retrospective register-based study in Finland. BJOG. 2012 Oct;119(11):1370–8.

19. van Bavel J, Hukkelhoven CWPM, de Vries C, Papatsonis DNM, de Vogel J, Roovers JPWR, 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 May;29(3):407–13.

20. Coats PM, Chan KK, Wilkins M, Beard RJ. A comparison between midline and mediolateral episiotomies. Br J Obstet Gynaecol. 1980 May;87(5):408–12.

21. Stedenfeldt M, Pirhonen J, Blix E, Wilsgaard T, Vonen B, Øian P. Episiotomy characteristics and risks for obstetric anal sphincter injuries: a case-control study. BJOG. 2012 May;119(6):724–30.

22. Muraca GM, Ralph LE, Christensen P, D’Souza R, Geoffrion R, Lisonkova S, et al. Maternal and neonatal trauma during forceps and vacuum delivery must not be overlooked. BMJ. 2023 Oct 19;383:e073991.

23. Baghestan E, Børdahl PE, Rasmussen SA, Sande AK, Lyslo I, Solvang I. A validation of the diagnosis of obstetric sphincter tears in two Norwegian databases, the Medical Birth Registry and the Patient Administration System. Acta Obstet Gynecol Scand. 2007;86(2):205–9.

24. Langhoff-Roos J, Krebs L, Klungsøyr K, Bjarnadottir RI, Källén K, Tapper AM, et al. The Nordic medical birth registers – a potential goldmine for clinical research. Acta Obstet Gynecol Scand. 2014 Feb;93(2):132–7.

25. Stedenfeldt M, Øian P, Gissler M, Blix E, Pirhonen J. Risk factors for obstetric anal sphincter injury after a successful multicentre interventional programme. BJOG. 2014 Jan;121(1):83–91.

26. Gyhagen M, Ellström Engh M, Husslein H, Koelbl H, Nilsson IEK, Schulz J, et al. Temporal trends in obstetric anal sphincter injury from the first vaginal delivery in Austria, Canada, Norway, and Sweden. Acta Obstet Gynecol Scand. 2021 Nov;100(11):1969–76.

27. 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(1):781.

28. Gurol-Urganci I, Bidwell P, Sevdalis N, Silverton L, Novis V, Freeman R, et al. Impact of a quality improvement project to reduce the rate of obstetric anal sphincter injury: a multicentre study with a stepped-wedge design. BJOG. 2021 Feb;128(3):584–92.

29. Eogan M, Daly L, O’Connell PR, O’Herlihy C. Does the angle of episiotomy affect the incidence of anal sphincter injury? BJOG. 2006 Feb;113(2):190–4.

30. Kalis V, Landsmanova J, Bednarova B, Karbanova J, Laine K, Rokyta Z. Evaluation of the incision angle of mediolateral episiotomy at 60 degrees. Int J Gynecol Obstet. 2011 Mar;112(3):220–4.