



Contents lists available at ScienceDirect

# European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: [www.elsevier.com/locate/ejogrb](http://www.elsevier.com/locate/ejogrb)

## Is episiotomy worthwhile to prevent obstetric anal sphincter injury during operative vaginal delivery in nulliparous women?



J. Boujenah<sup>a,b,\*</sup>, A. Tigaizin<sup>a</sup>, M. Fermat<sup>a</sup>, R. Murtada<sup>a</sup>, A. Benbara<sup>a</sup>, M. Benchimol<sup>a</sup>, I. Pharisien<sup>a,b</sup>, L. Carbillon<sup>a,b</sup>

<sup>a</sup> Pôle femme et enfant, groupe hospitalier universitaire Paris Seine Saint-Denis, site Jean-Verdier, avenue du 14 Juillet, 93140 Bondy, France

<sup>b</sup> Université Paris 13, Sorbonne Paris cité, UFR SMBH, 93000, Bobigny, France

### ARTICLE INFO

#### Article history:

Received 5 September 2018

Received in revised form 11 November 2018

Accepted 12 November 2018

#### Keywords:

Episiotomy  
Obstetric anal sphincter injury  
Operative vaginal delivery  
Occiput posterior  
Nulliparous

### ABSTRACT

**Objectives:** Episiotomy is a marker of Obstetric Anal Sphincter Injury (OASIS) condition, therefore, unmeasured factors could have biased the strength of the association between episiotomy and reduced OASIS during Operative Vaginal Delivery (OVD). The aim of this study was to compare the OASIS rate during OVD according to episiotomy practice.

**Study Design:** Retrospective cohort study of all nulliparous pregnant women attempting an OVD between 2014–2017. To avoid unmeasured bias, all maternal and delivery data were prospectively captured after the birth. The strong relationship between parity and episiotomy practice (indication bias) lead to analyze only nulliparous women. Association between mediolateral episiotomy and OASIS following OVD was performing by using multivariate logistic regression analysis including significant variable in univariate analysis and relevant factors known to be associated both with OASIS and/or OVD.

**Results:** Over the study period, 1709 (17.1%) women had an OVD, among them 40 (2.3%) had OASIS. In the 1342 (78.5%) nulliparous women, OASIS rate were 2% and 5.1% with and without episiotomy ( $p < 0.01$ ). In multivariate analysis a lower incidence of OASIS with the use of episiotomy (OR 0.267 IC 0.132–0.541) were observed. The persistent occiput posterior position was associated with an increase risk of OASIS (OR 6.742 IC 2.376–19.124). Spatula/forceps, as compared to vacuum operative vaginal delivery increased the risk OASIS (OR 2.847 IC 1.311–7.168). Area under the curve of the model was 0.745.

**Conclusion:** Episiotomy is a modifiable risk factors which can contribute to reduce the risk of OASIS in nulliparous women with operative vaginal delivery. This intervention should be included in a global management of the second stage of labor

© 2018 Elsevier B.V. All rights reserved.

### Introduction

Operative vaginal delivery (OVD) is an important risk factor for obstetric anal sphincter injury (OASIS) [1], with vacuum [2] as well as forceps delivery (even higher risk than vacuum delivery) (3). Selective or routine episiotomy during OVD remains a matter of debate because of large practice variations [4].

However a simultaneous trend between a lower rate of episiotomy during OVD and a higher risk of OASIS has been observed in several countries with reliable national population-based databases [1–5]. At the same time, a significant decrease in the risk of OASIS was achieved with the introduction of a specific care for

perineal protection including episiotomy during OVD, [6], including episiotomy [7]. Nevertheless unmeasured factors within observational studies could have biased the strength of the association [8]. Three groups of confounding factors (that contribute to OASIS) can be identified: the indication of OVD [9,10], the type and technique of episiotomy [11,12] and maternal characteristics [13]. When controlling for these factors, episiotomy could show a benefit for reducing OASIS whatever the mode of delivery [14]. Actually some changes in the practice of episiotomy are observed. Women with a high risk of OASIS often have episiotomy [9,15]. Recently the RCOG produced an evidence level III guideline [10] stating that in nulliparous women, mediolateral episiotomy reduced the risk of OASIS (RR 0.67 95% CI 0.49–0.92) in OVD. Over the past decade, the rate of episiotomy in France decreased (26.7% in 2007 to 19.9% in 2017) [16]. Hence, results of study need to be adjusted for confounding factors by indication because episiotomy is a marker of OASIS condition. Parity is an important confounding factor. There is a relationship between women

\* Corresponding author at: Pôle femme et enfant, groupe hospitalier universitaire Paris Seine Saint-Denis, site Jean-Verdier, avenue du 14 Juillet, 93140 Bondy, France.  
E-mail address: [jeremy.boujenah@gmail.com](mailto:jeremy.boujenah@gmail.com) (J. Boujenah).

with multiparous women (i.e. previous vaginal delivery) and episiotomy practice or OASIS [10]. Because of this indication bias, studies need to distinguish nulliparous and multiparous.

The aim of the study was to compare the OASIS rate during OVD according to episiotomy practice in a current French modern obstetrical cohort of nulliparous women.

## Material and method

### Cohort study

We conducted a retrospective cohort study of all pregnant women attempting an OVD between 2014–2017 in an Obstetrics and Gynecology teaching department. Data were gathered from a tertiary care university hospital registry. Obstetrical data are routinely captured at birth for all women who give birth in our hospital by the practitioner assisting the delivery. Following the delivery, these data are reviewed by a single midwife who is qualified in data management and storage. All pregnant women booked to deliver in our University Hospital are informed that data are routinely entered at birth into an electronic record keeping system for contributing to the PMSI (national “Programme de médicalisation des systèmes d’information”) database, and that indicators of perinatal health are analyzed to allow for continuous feedback and improvement of the procedures of care.

### Management of the second stage of labor and OVD

Length of the second stage of labor was 2 up to 3 h according to previous scar cesarean, fetal heart rate tracing, fetal head station and degrees of staining of meconium stained amniotic fluid. Oxytocin was used after 1 h of no progression of the fetal head position. Active second stage of birth was defined as commencement of active pushing until delivery of the infant. Labor and OVD ward protocols are daily implemented at staff meetings and provide guidance on the good practice according to the published French guidelines [17]: Ruptured membranes, fully dilated cervix, fully engaged fetal head in the midpelvis, fetal head position is known, appropriate maternal analgesia, rigorous asepsis, an empty bladder, and no fundal uterus protrusion.

An attempt of manual rotation is performed in cases of persistent occiput posterior position.

OVD is performed in case of abnormal fetal heart rate according to Melchior Classification, and in case of slow progression of fetal head after 30 min of pushing.

In non assisted vaginal delivery the policy of episiotomy is restrictive.

However, in OVD the approach to use of episiotomy is left to the individual practitioner or supervising senior obstetrician according to own experience and the specific case.

During OVD, the choice between vacuum or spatula/forceps is decided by the area expertise of each practitioner.

Our department is a teaching hospital, with incoming first year junior student. Therefore all OVD were performed either senior obstetrician or under supervising senior.

Women were eligible for inclusion in the study if the term was > 34 weeks of pregnancy, with a live singleton pregnancy and cephalic presentation.

Intra-uterine fetal deaths, women with  $\geq 2$  previous cesarean section (CS), women with newborn with congenital anomalies, women with missing data were excluded.

### Explanatory variables

Detailed data on maternal (age, BMI, parity, previous OVD, previous vaginal delivery, size) and infant (weight) characteristics,

intrapartum (amniotic fluid, fever, use of oxytocin, epidural analgesia, and length of labor), postnatal factors (APGAR, measurement of pH and lactates) and the outcome measures of interest were recorded. Especially, confounding characteristics of the operative vaginal delivery were extracted: aetiology of OVD, fetal head station, fetal head position, type of instrument (vacuum, spatula, and forceps), length of expulsive stage, use of two instruments, cephalic perimeters of the newborn, ethnicity, previous (CS), manual rotation, instrumental rotation.

Nulliparous women were defined as women without previous third trimester vaginal delivery. Women with only previous (CS) were also considered as nulliparous women.

### Primary and secondary outcome

The primary outcome measure was extensive perineal tearing involving the anal sphincter (third- or fourth-degree tears) (Obstetric Anal Sphincter Injury “OASIS”). Classification of anal sphincter tears was according to the Royal College of Obstetricians and Gynecologists (RCOG) green-top guideline. A third-degree rupture involves the external anal sphincter and a fourth-degree rupture affects both the anal sphincter and the anorectal mucosa. In all of the analyses, data on third-degree (36 women – 2% of the cohort – 90% of the OASIS) and fourth-degree (4 women – 0.2% of the cohort, 10% of the OASIS) obstetric anal sphincter ruptures were pooled because these lesions share similar risk factors and are commonly considered together.

Because the risk of OASIS is thought to be far greater in forceps/spatula than vacuum operative deliveries [17,18], spatula and forceps were pooled to increase the power of the study. The OASIS rate is an important obstetrical indicators that is monthly reviewed and published in our center (as the rate of episiotomy, cesarean section and perinatal asphyxia). Annually the database system and monthly reviews are matched for these obstetrical indicators.

### Statistical analysis

We used descriptive statistics of the factors to characterize the cohort in relation to use of episiotomy.

Statistical analyses were performed using Stata software (Stata, version 11.0, StatCorp LP, USA, [www.stata.com](http://www.stata.com)). Descriptive data analysis was performed using the Student test, and variance analysis was performed using ANOVA for continued variables when comparing more than two categories (two-way ANOVA). The chi-squared test or Fisher exact test was used for qualitative variables when  $n < 0.05$ . For quantitative variable, non-parametric test were used (mann-withney and kruskal-wallis).

Correlation between variables was tested par by using Pearson test for continuous variable and point biserial test for dichotomic variables-continuous variable.

Intent to treat analysis (i.e. by attempting operative vaginal delivery) was performed.

For nulliparous women, individual preference for vacuum or spatula/forceps operative deliveries could have resulted in a measurement bias. Therefore in nulliparous women, we separately analyzed the main outcome according to mode of operative vaginal delivery (vacuum or forceps/spatula).

Multivariate logistic regression analyses were used to model the risk factors of OASIS among nulliparous women according to episiotomy practice. The main goal of the multivariate analysis was to consider variable that could be related to episiotomy practice during OVD. OASIS was chosen as the dependent variable. Backward stepwise regression was used. We selected significant variables ( $P < 0.2$ ) based on univariate analysis. Forced-in variables that were known to be related to OASIS, and therefore that could be associated both with OASIS [1,19,20] and/or operative vaginal

delivery [21,22] were also selected. Multicollinearity test were used before including variables to strengthen the associations. Variables without strong multicollinearity and that were clinical of interest were included in the model.

## Results

Over the study period, 1709 (17.1%) women had an OVD. For reference purpose only, the rate of cesarean section was 21.1%. The global rate of OASIS (spontaneous and OVD) was 0.8%. The number of nulliparous and multiparous women with OVD was 1342 (785%) and 367 (21.5%), respectively.

In this cohort of OVD, OASIS occurred in 40 (2.3%) women (3 in multiparous and 37 in nulliparous women). In the whole population of our hospital, between 2014–2017, a trend for lower global episiotomy rate were observed: 18.7%, 19%, 20% and 14% ( $p=0.35$ ). In the group of OVD, a similar diminished trend in episiotomy rate were observed: 80%, 76.6%, 72.3%, 54.3% ( $p=0.18$ ).

In nulliparous women, OASIS occurred in 37 (2.7%) cases, 4 (11.1%) of which were fourth-degree ruptures.

Episiotomy was more frequent in case of forceps/spatula than vacuum operative vaginal delivery (836% versus 604%,  $p<0.05$ ).

OASIS rate was lower in case of OVD with episiotomy vs without episiotomy (2% versus 5.1%,  $p<0.05$ ). In sub-group analysis, according to mode of assisted delivery, a non-significant trend to less OASIS rate was observed in vacuum delivery with episiotomy vs without (0.8% versus 2.1%) while a significantly higher OASIS rate was observed in forceps/spatula delivery with episiotomy versus without episiotomy (2.4% versus 7.7%,  $p<0.05$ ).

Basal characteristics of nulliparous women are shown in Table 1. Apart from the ethnicity (slight difference), and the mode of OVD, there were no significant difference between women with or without episiotomy.

When analyzing basal characteristics of nulliparous women according to mode of OVD, vacuum operative delivery was performed in 394 (29.4%) women, 238 (60.4%) of which had an episiotomy. Spatula/forceps delivery was performed in 948 (70.6%) women, 793 (83.6%) of which had an episiotomy.

In these sub-group analysis, according to mode of assisted delivery, a non-significant trend to lower OASIS rate was observed

**Table 1**  
Univariate analysis in attempted of OVD according to episiotomy practice in nulliparous women.

Nulliparous	OVD with episiotomy N = 1031 n(%) +/-SD	OVD without episiotomy N = 311 n(%) +/-SD	P value
OASIS	21 (2%)	16 (5.1%)	<0,01
Age (years)	287 (+/-5.5)	289 (+/-5.4)	
Ethnicity			
	Caucasian	132 (424%)	<0,01
	Afro-caribbean	39 (125%)	0,63
	Asiatic	37 (119%)	0,03
	Arabic	92 (296%)	0,18
	Turkish	9 (2,9%)	0,66
	Travellers	2 (0,6%)	0,81
Previous cesarean section	123 (119%)	35 (112%)	0,4
Previous operative vaginal delivery	NA	NA	
Height (cm)	163 (+/-6.6)	164 (+/-6.1)	0,81
Weight (kg)	641 (+/-13.3)	65 (+/-14.3)	0,41
Gain weight pregnancy	11,6 (+/-5.8)	111 (+/-5)	0,74
Body Mass Index	2(+/-4.6)	24 (+/-5.2)	0,81
Term Delivery (WP)	40 (+/-1.9)	39+6 (+/-1.6)	0,24
Length of labor (min)	530 (+/-230)	485 (+/-240)	0,34
Length of expulsive stage (min)	25 (+/-11.5)	26 (+/-12.3)	0,65
Birthweight	3282 (+/-461)	3241 (+/-455)	0,45
Birthweight (>3500 g)	337 (327%)	88 (38%)	0,14
Cephalic head circumference	34,7 (+/-3.2)	35 (+/-3.4)	0,34
Fetal Head position during labor			
	Anterior	215 (691%)	0,46
	Posterior	68 (219%)	0,3
	Transvers	23 (7,4%)	0,74
	Unknown	5 (1,6%)	0,96
Occipito posterior fetal head position at OVD	33 (3,2%)	7 (2,2%)	0,38
Unknown occipito posterior fetal head position	11 (1%)	1 (0,3%)	
Epidural analgesia	992 (962%)	294 (95%)	0,19
Meconium stained amniotic fluid	114 (11%)	46 (148%)	0,07
Indication for OVD			
	Abnormal FHR	111 (357%)	0,7
	Ineffective maternal effort	132 (424%)	0,41
	Both FHR and maternal effort	68 (218%)	0,18
Type of OVD	Spatula/forceps	155 (498%)	<0,01
	Vacuum	156 (502%)	<0,01
Fetal head station at OVD			
	at or below 0	92 (399%)	0,53
	Between -2 and < 0	214 (688%)	0,14
	Above -2	5 (0,2%)	0,02
Sequential use of instruments	54 (5,2%)	16 (5,1%)	0,94
Vacuum assisted fetal head rotation	21 (2%)	2 (0,06%)	0,09
Loss of blood at delivery (<500 ml)	95 (9,2%)	22 (7%)	0,24
Perineal loss of blood	30 (2,9%)	6 (1,9%)	0,34
Cervical or vaginal laceration	9 (0,8%)	0 (0%)	N/A

in vacuum delivery with episiotomy (0.8% versus 2.1%) while a significantly higher OASIS rate was observed in forceps/spatula delivery without episiotomy (2.4% versus 7.7%,  $p < 0.05$ ).

When considering basal characteristic according to mode of delivery, a trend for a higher occiput posterior (OP) fetal head position and a higher fetal head station rate (midcavity) at the operative vaginal were observed in case of forceps/spatula than vacuum operative delivery (3.7% vs 1.5%,  $p = 0.1$ ; 39.1% vs 24.1%,  $p < 0.05$  respectively).

To adjust the effect of episiotomy we performed an multivariate analysis. Firstly we observed strong multicollinearity between explanatory variables: birthweight/indication of OV, birthweigh/occiputposterior position, type of instruent/fetal head station.

In nulliparous women the multivariate analysis showed a lower incidence of OASIS with the use of episiotomy whatever the mode of assisted delivery (OR 0.267 IC 0.132-0.541). The persistent OP position was associated with an increased risk of OASIS (OR 6.742 IC 2,376-19,124). Spatula/forceps, as compared to vacuum operative vaginal delivery increased the risk OASIS (OR 2.847 IC 1.131–7,168). Area under the curve of the model was 0.745. P-value of Hosmer-Lemeshow test was 0.87 ( $> 0.05$ ) (Table 2).

**Discussion**

*Main findings*

We found that episiotomy associated with OVD was an independent factor for reducing OASIS only in nulliparous women. The higher risk of OASIS was notably observed with the use of spatula/forceps without episiotomy for OP fetal head position in nulliparous women. Therefore, in our multivariate analysis, the main findings (practice of episiotomy, OP, spatula/forceps) concerned both modifiable risk variables.

*Strength and limitations*

Firstly the strength of the study is the unicentric, reproducible and wards protocol practice. The rate of episiotomy and OASIS are in line with those of national database [4]. Secondly, the database of our hospital contains all variables that could be associated with OASIS and episiotomy. Prospective collect and control of the storage secure the validity of the data.

The main limit of our study could be the under diagnosis of the OASIS, especially in the group of episiotomy. In case of large lacerations with episiotomy, OASIS diagnosis could have been missed. We did not use endoanal ultrasound in delivery room [23] or in the postpartum period [24]. Another limit of our study is that we could not analyze the type of episiotomy [11]. The third limit is that our database does not contain information about long term complication (fecal or urinary incontinence).

*Interpretation*

Episiotomy was associated with a 72% decreased risk of OASIS in nulliparous women, with the shortest confidence interval of the model. Raisonen et al found the same protective effect of

episiotomy for nulliparous women alone (odds ratio 0.54, 95% CI 0.42-0.70) [2]. Conversely to multiparous, in nulliparous women, the manual support techniques during delivery could be more difficult due to more resilient tissue [25,26] and the absence of pelvis muscle changing.

In nulliparous women, the observed protective effect of episiotomy is in line with the time trends and risk factors found in the English retrospective cohort of 1 035 253 primiparous (Forceps with and without episiotomy: aOR 1.34 vs 6.34 and vacuum with and without episiotomy :aOR 0.57 vs 1.59) [1].

The increased risk of OASIS in OP associated OVD observed in this cohort is consistent with previous published studies with forceps [27], spatula [28] and vacuum operative vaginal delivery [29]. The larger circumference diameters in OP, the deflexion of the head and the least control of the perineal stretching during OVD could increase injuries of the levatori ani. Indeed the stretch of levatori ani is influenced both by the initial length of each muscle and also by the degree of elongation that occurs during the stretching caused by the fetal head. [30].

To reduce perineal trauma, our analysis focused on modifiable risk factors. Interventional program showed a substantial benefit effect of episiotomy to reduce OASIS [25,31,32]. In a concomitant way, manual perineal support techniques and modifiable risk factors should be treated.

Firstly, diagnosis and management (manual rotation) of OP to occiput anterior position could reduce the risk of OASIS during OVD [33].

Secondly, based on Stedenfelt et al study [11], Trigonometric measures of the episiotomy are significantly associated with less risk of OASIS (length  $> 17$  mm, and angle range from anus  $> 30-60^\circ$ ). Implementation guideline of techniques could reduce the OASIS burden in nulliparous with OVD [7]. RCOG even promoted for a new specific scissor ensuring a minimal  $50^\circ$  angle [7,34].

Thirdly, episiotomy should be considered in case of nulliparous women with OVD, notably in the event of forceps/spatulas use.

Fourthly the choice between vacuum and spatula/forceps remains a matter of debate according to skills and operator training [35].Indeed, in OP position, a lower perineal risk with vacuum assisted delivery than with forceps was suggested, but in line with our results, failure rate with vacuum at mid position was found higher than at low position [36]. To reduce perineal trauma with spatula/forceps, the blade of spatula/forceps should be disarticulated and removed before the delivery of the head.

Lastly, the length of the second stage of labor and/or expulsive effort should be examined. On the one hand, increased maternal risk OASIS is associated with the duration of the second stage [37]. On the other hand, delayed pushing is associated with an increase in spontaneous vaginal delivery [38]. Such a delay may probably be fruitful if this time is used to obtain to improve uterine contractility and a rotation of the fetal head in occiput anterior if needed.

Such cohort study and analysis should be performed in all obstetrical departments in order to observe modifiable risk factors [39]. Next to this analysis, we implemented a new program for practitioners to highlight the risk of OASIS, and the need for a more carefully support of perineum during delivery especially in case of OVD.

All these considerations (perineal protection, possible episiotomy, risk of persistent OP position), should be explained/shared with the pregnant women during antenatal consultation [32].

**Table 2**  
Multivariate analysis for the risk of OASIS in nulliparous women OVD: Operative vaginal delivery.

Variables	OR	CI 95%
Birthweight $> 3500$ g	2,355	1,202–4,615
Occipito posterior position	6,742	2,376–19,124
Spatula/forceps (vs vacuum)	2,847	1,311–7,168
Episiotomy	0,267	0,132–0,541

**Conclusion**

Episiotomy is modifiable risk factors which can contribute to reduce the risk of OASIS in nulliparous women with operative vaginal delivery. This intervention should be included in a global

management of the second stage of labor and the delivery for preventing OASIS.

## References

- [1] 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; (120):1516–25.
- [2] 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;119:1370–8.
- [3] Halle TK, Salvesen KÅ, Volløysaug I. Obstetric anal sphincter injury and incontinence 15–23 years after vaginal delivery. *Acta Obstet Gynecol Scand* 2016;95:941–7.
- [4] Blondel B, Alexander S, Bjarnadóttir RI, Gissler M, Langhoff-Roos J, Novak-Antolič Ž, et al. Variations in rates of severe perineal tears and episiotomies in 20 European countries: a study based on routine national data in Euro-Peristat Project. *Acta Obstet Gynecol Scand* 2016;95:746–54.
- [5] Räisänen S, Vehviläinen-Julkunen K, Gissler M, Heinonen S. Hospital-based lateral episiotomy and obstetric anal sphincter injury rates: a retrospective population-based register study. *Am J Obstet Gynecol* 2012;206(347):e1–6.
- [6] 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.
- [7] Mohiuddin H, Ali S, Pisal PN, Villar R. Implementation of the RCOG guidelines for prevention of obstetric anal sphincter injuries (OASIS) at two London Hospitals: a time series analysis. *Eur J Obstet Gynecol Reprod Biol* 2018;224:89–92.
- [8] Psaty BM, Siscovick DS. Minimizing bias due to confounding by indication in comparative effectiveness research: the importance of restriction. *JAMA* 2010;304:897–8.
- [9] Räisänen S, Cartwright R, Gissler M, Kramer MR, Laine K, Jouhki M-R, 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.
- [10] <https://www.rcog.org.uk/en/guidelines-research-services/guidelines/episiotomy-query-bank/>.
- [11] 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;119:724–30.
- [12] Eogan M, Daly L, O'Connell PR, O'Herlihy C. Does the angle of episiotomy affect the incidence of anal sphincter injury? *BJOG* 2006;113:190–4.
- [13] Macleod M, Goyder K, Howarth L, Bahl R, Strachan B, Murphy DJ. Morbidity experienced by women before and after operative vaginal delivery: prospective cohort study nested within a two-centre randomised controlled trial of restrictive versus routine use of episiotomy. *BJOG* 2013;120:1020–6.
- [14] Räisänen S, Selander T, Cartwright R, Gissler M, Kramer MR, Laine K, et al. The association of episiotomy with obstetric anal sphincter injury—a population based matched cohort study. *PLoS One* 2014;9:e107053.
- [15] Verghese TS, Champaneria R, Kapoor DS, Latthe PM. Obstetric anal sphincter injuries after episiotomy: systematic review and meta-analysis. *Int Urogynecol J* 2016;27:1459–67.
- [16] Goueslard K, Cottenet J, Roussot A, Clesse C, Sagot P, Quantin C. How did episiotomy rates change from 2007 to 2014? Population-based study in France. *BMC Pregnancy Childbirth* 2018;(18):208.
- [17] Vayssière C, Beucher G, Dupuis O, Feraud O, Simon-Toulza C, Sentilhes L, et al. Instrumental delivery: clinical practice guidelines from the French College of Gynaecologists and Obstetricians. *Eur J Obstet Gynecol Reprod Biol* 2011;159:43–8.
- [18] Hamilton EF, Smith S, Yang L, Warrick P, Ciampi A. Third- and fourth-degree perineal lacerations: defining high-risk clinical clusters. *Am J Obstet Gynecol* 2011;204(309):e1–6.
- [19] Hudelist G, Gelle'n J, Singer C, Ruecklinger E, Czerwenka K, Kandolf O, et al. Factors predicting severe perineal trauma during childbirth: role of forceps delivery routinely combined with mediolateral episiotomy. *Am J Obstet Gynecol* 2005;192:875–81.
- [20] Hirayama F, Koyanagi A, Mori R, Zhang J, Souza JP, Gülmezoglu AM. Prevalence and risk factors for third- and fourth-degree perineal lacerations during vaginal delivery: a multi-country study. *BJOG* 2012;119:340–7.
- [21] de Leeuw JW, de Wit C, JPJA Kuijken, Bruinse HW. Mediolateral episiotomy reduces the risk for anal sphincter injury during operative vaginal delivery. *BJOG* 2008;115:104–8.
- [22] Baghestan E, Irgens LM, Børndahl PE, Rasmussen S. Trends in risk factors for obstetric anal sphincter injuries in Norway. *Obstet Gynecol* 2010;116:25–34.
- [23] Walsh KA, Grivell RM. Use of endoanal ultrasound for reducing the risk of complications related to anal sphincter injury after vaginal birth. *Cochrane Database Syst Rev* 2015 CD010826.
- [24] Oberwalder M, Connor J, Wexner SD. Meta-analysis to determine the incidence of obstetric anal sphincter damage. *Br J Surg* 2003;(90):1333–7.
- [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;121:83–91.
- [26] Waldenström U, Ekéus C. Risk of obstetric anal sphincter injury increases with maternal age irrespective of parity: a population-based register study. *BMC Pregnancy Childbirth* 2017;17(306).
- [27] 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;192:1702–6.
- [28] Guerby P, Parant O, Chantalat E, Vayssière C, Vidal F. Operative vaginal delivery in case of persistent occiput posterior position after manual rotation failure: a 6-month follow-up on pelvic floor function. *Arch Gynecol Obstet* 2018;298:111–20.
- [29] 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;193:525–8 discussion 528–529.
- [30] Lien K-C, Mooney B, DeLancey JOL, Ashton-Miller JA. Levator ani muscle stretch induced by simulated vaginal birth. *Obstet Gynecol*. janv 2004;103(1):31–40.
- [31] Hals E, Oian 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;116(4):901–8.
- [32] Laine K, Pirhonen T, Rolland R, Pirhonen J. Decreasing the incidence of anal sphincter tears during delivery. *Obstet Gynecol* 2008;111:1053–7.
- [33] Hirsch E, Elue R, Wagner A, Nelson K, Silver RK, Zhou Y, et al. Severe perineal laceration during operative vaginal delivery: the impact of occiput posterior position. *J Perinatol* 2014;34:898–900.
- [34] Management of third and fourth degree perineal tears. *Green Top Guideline 29*; Royal College of Obstetricians and Gynaecologists. RCOG press; 2015.
- [35] O'Mahony F, Hofmeyr GJ, Menon V. Choice of instruments for assisted vaginal delivery. *Cochrane Database Syst Rev* 2010 CD005455.
- [36] Damron DP, Capeless EL. Operative vaginal delivery: a comparison of forceps and vacuum for success rate and risk of rectal sphincter injury. *Am J Obstet Gynecol* 2004;191:900–10.
- [37] Rouse DJ, Weiner SJ, Bloom SL, Varner MW, Spong CY, Ramin SM, et al. Second-stage labor duration in nulliparous women: relationship to maternal and perinatal outcomes. *Am J Obstet Gynecol* 2009;201(357):e1–7.
- [38] Lemos A, Amorim MM, Dornelas de Andrade A, de Souza AI, Cabral Filho JE, Correia JB. Pushing/bearing down methods for the second stage of labour. *Cochrane Database Syst Rev* 2017;26(3) CD009124.
- [39] Jangö H, Langhoff-Roos J, Rosthøj 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):e1–6.