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Anal sphincter lacerations and upright delivery postures—a risk analysis from a randomized controlled trial

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Abstract *Objective:* To evaluate obstetric sphincter lacerations after a kneeling or sitting position at second stage of labor in a multivariate risk analysis model. *Materials and methods:* Two hundred and seventy-one primiparous women with normal pregnancies and spontaneous labor were randomized, 138 to a kneeling position and 133 to a sitting position. Medical data were retrieved from delivery charts and partograms. Risk factors were tested in a multivariate logistic regression model in a stepwise manner. *Results:* The trial was completed by 106 subjects in the kneeling group and 112 subjects in the sitting group. There were no significant differences with regard to duration of second stage of labor or pre-trial maternal characteristics between the two groups. Obstet-

rical sphincter tears did not differ significantly between the two groups but an intact perineum was more common in the kneeling group ($p<0.03$) and episiotomy (mediolateral) was more common in the sitting group ($p<0.05$). Three grade IV sphincter lacerations occurred in the sitting group compared to none in the kneeling group (NS). Multivariate risk analysis indicated that prolonged duration of second stage of labor and episiotomy were associated with an increased risk of third- or fourth-degree sphincter tears ($p<0.01$ and $p<0.05$, respectively). Delivery posture, maternal age, fetal weight, use of oxytocin, and use of epidural analgesia did not increase the risk of obstetrical anal sphincter lacerations in the two upright postures. *Conclusion:* Obstetrical anal sphincter lacerations did not differ significantly between a kneeling or sitting upright delivery posture. Episiotomy was more common after a sitting delivery posture, which may be associated with an increased risk of anal sphincter lacerations. Upright delivery postures may be encouraged in healthy women with normal, full-term pregnancy.

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Summary Kneeling and sitting upright during delivery does not differ significantly in pelvic floor lacerations or immediate post-partum morbidity.

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Introduction

Risk factors for anal sphincter laceration at childbirth may be divided into maternal, fetal, and obstetrical causes. Nulliparity, fundal pressure, midline episiotomy, instrumental delivery, and fetal weight are some of the factors widely recognized to be associated with an increased risk of anal sphincter laceration at delivery [1]. There has been less focus on the importance of maternal delivery postures in regard to obstetrical sphincter tears.

Upright delivery positions have become popular in recent decades, yet there is a lack of evidence on the importance of various delivery postures on maternal morbidity [2]. Comparisons on delivery outcome after various maternal postures during labor commonly focus on differences between upright and dorsal positions [3–6].

Upright delivery postures may increase pelvic dimensions [7] and have beneficial effects on uterine contractility [8], possibly shortening the duration of labor. In an observational study by Zetterstrom et al. [1], upright delivery positions without additional perineal protection were not associated with an increased risk of sphincter tears at delivery although the opposite has been suggested [9].

It is plausible that various upright delivery positions may differ from one another in maternal outcome, although evidence is scarce. The lack of data have been an obstacle when attempting to form evidence-based recommendations on the appropriateness of various delivery positions in daily obstetrical management [2].

We have previously reported our results from a randomized controlled trial focusing on duration of labor and maternal experience after either a sitting upright or a kneeling delivery position [10]. The purpose of the present study was to compare two upright delivery positions in regard to pelvic floor lacerations in a multivariate risk analysis model.

Materials and methods

The study was conducted at Västerås County Hospital, Sweden between April 1998 and September 1999. Primiparous subjects with a normal pregnancy, singleton fetus in cephalic presentation, and spontaneous labor in gestation week 37–42 entered the trial when admitted to the hospital delivery ward. After receiving oral and written information by the responsible midwife, subjects gave their informed consent, documented in the patient's charts. Randomization was performed by the midwife before the subject entered the second stage of labor. The subjects were assigned to a kneeling or sitting position by drawing the next consecutive, opaque envelope placed randomly in a box at the delivery ward. The position assigned was assumed just before entering the second stage of labor, defined as a fully dilated and retracted cervix with occiput internal rotation complete as determined through vaginal examination by the midwife.

Women were assigned either to a kneeling position, leaning towards the head of the delivery bed or a cushion, or to a sitting position in the delivery bed, with the head of the bed raised at least 60 degrees from horizontal. For randomization to be complete, the assigned delivery position was to be maintained until the fetus crowned.

There were no restrictions on the management of labor or maternal position before entering the second stage of labor. Episiotomy was performed at the discretion of the midwife and was carried out using a mediolateral incision in all cases.

Perineal tears were classified according to the ICD-10 nomenclature [11]. Grade I and II, vaginal and perineal, lacerations were classified and sutured by the midwife, unless assistance by a physician was required; grade III and IV obstetrical tears were classified and sutured by the obstetrician on call.

There were 271 patients randomized, 138 to the kneeling position and 133 to the sitting position (Table 1). The number of patients and reasons for discontinuing the trial are presented in Fig. 1. Detailed data on maternal and fetal outcome were obtained from individual delivery partograms and charts. Seventeen patients eligible for participation in the trial declined, the majority of which did not want to be restricted to either position.

Statistics and ethical considerations

A pre-trial power calculation determined that a sample size of at least 100 patients in each group would be able to detect a 25% difference in duration of second stage of labor with 80% power and an α -level of 0.05 (two-sided). For the purpose of the present study, statistical analyses were restricted to subjects that completed the study as randomized. All analyses were performed blinded to group allocation until completed. Analysis on covariates was performed using a logistic regression model in the two groups separately and combined. Variables showing statistical significance at univariate regression were tested in a stepwise multivariate regression model. Non-parametric ordinal data were analyzed using Mann–Whitney *U* test. $P < 0.05$ was considered significant for all analyses. The study was approved by the ethics committee at Uppsala University, Uppsala, Sweden.

Results

The trial was completed as randomized by 106 subjects in the kneeling group and 112 subjects in the sitting group. The trial was discontinued by 32 of 138 subjects (23%) in the kneeling group and 21 of 133 subjects (16%) in the

Table 1 Descriptive group statistics

	Kneeling position	Sitting position	Mann–Whitney <i>U</i> test
Randomized number of subjects	138	133	NS
Completed study as randomized ^a	106 (77)	112 (84)	NS
Maternal age ^b (years)	26.4±4.0	26.5±4.3	NS
Gestational week ^b	39+1	39+4	NS
Cervix dilation at entry ^b (cm)	3.6±2.2	3.2±2.1	NS
Duration of labor (h)	9.4±5.8	9.1±4.6	NS
Duration of second stage ^b (min)	44.5±25.6	39±20.6	NS
Birth weight ^b (g)	3564±392	3567±485	NS

^aNumber of subjects (%)

^bMean±SD

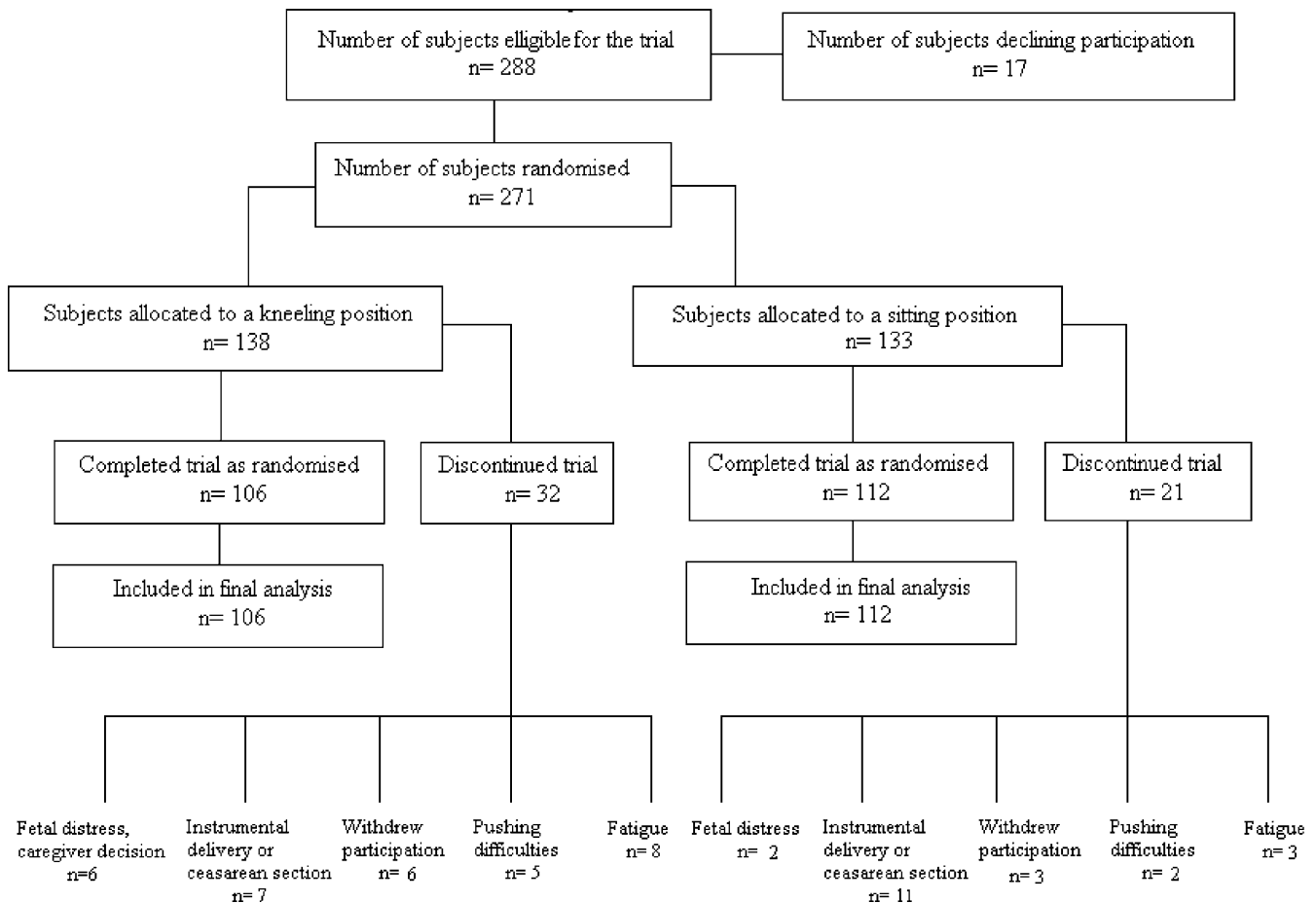


Fig. 1 Trial subject chart flow

sitting group ($p=0.2$) (Fig. 1). There were no significant differences in maternal characteristics between subjects not completing the study after randomization. The mean age of these patients was 27.2 ± 4.2 years (mean $\pm$ S.D) in the kneeling group and 26.9 ± 3.6 years (mean $\pm$ S.D) in the sitting group. The main reasons for discontinuing the trial are listed in Fig. 1.

Neither duration of labor nor duration of second stage of labor differed significantly between the groups (Table 1). There were no significant differences between the groups with respect to maternal pre-trial or delivery characteristics (Tables 1 and 2). There were no significant differences between the groups regarding subjects withdrawing or being excluded from the trial (Fig. 1).

Episiotomy was significantly more common in the sitting group ($p<0.05$) and an intact perineum was significantly more common in the kneeling group ($p<0.05$) (Table 2). Intrapartum analgesia, oxytocin augmentation of labor, duration of labor, fetal weight, and maternal age were not associated with an increased risk of episiotomy at multivariate regression analysis.

There were no significant differences between the groups when comparing all degrees of obstetrical tears. There were three cases of grade IV perineal lacerations in the sitting group compared to none in the kneeling group (NS). Multivariate analysis of covariables showed that an

increased duration of second stage of labor and episiotomy were associated with a significantly increased risk of third- or fourth-degree sphincter tear ($p<0.01$) (Table 3). Assigned delivery posture, intrapartum analgesia, oxytocin augmentation of labor, fetal weight, and maternal age were not associated with an increased risk of anal sphincter lacerations at multivariate regression analysis.

There were no critical maternal or fetal complications during the trial. Maternal morbidity described as postpartum hemorrhage did not differ significantly between the kneeling and sitting group and the number of placental retention was inadequate for statistical analysis (Table 2). Multivariate analysis of covariables showed that increasing maternal age, increasing fetal weight, duration of second stage of labor, and use of oxytocin during the second stage of labor were associated with an increased risk of maternal bleeding in excess of 500 ml (Table 3).

Discussion

Upright delivery positions are becoming increasingly popular and are considered by some as more natural as women of primitive cultures often assumed an upright birthing posture when giving birth [12]. Obstetricians in Western society sometimes disregard upright delivery

Table 2 Comparison of kneeling and sitting at delivery

	Kneeling position (n=106)	Sitting position (n=112)	Multivariate logistic regression OR (95% CI)
Interventions during labor			
TNS	1	2	–
Acupuncture	58	52	0.7 (0.4–1.3), <i>p</i> =0.3
Nitrous oxide	74	89	0.6 (0.3–1.1), <i>p</i> =0.07
Morphine	9	12	1.6 (0.6–4.1), <i>p</i> =0.3
Epidural anesthesia	48	54	0.9 (0.5–1.5), <i>p</i> =0.6
Spinal anesthesia	0	0	–
Paracervical block	2	4	–
Pudendal block	0	0	–
No analgesia	8	7	1.5 (0.7–3.1), <i>p</i> =0.3
Augmentation of labor (oxytocin 10 IE/500 ml NaCl)	52 (49)	62 (55)	0.7 (0.4–1.2), <i>p</i> =0.2
Episiotomy	2	11 (10)	5.7 (1.2–26.7), <i>p</i> =0.03
Instrumental delivery	7 (22)	9 (43)	0.7 (0.5–1.1), <i>p</i> =0.08
Post-partum characteristics			
Manual placental extraction	1	3	–
Maternal bleeding (ml)	420±320	480±406	1.2 (0.4–4.1), <i>p</i> =0.7
Maternal bleeding >1,000 ml	7 (7)	8 (7)	1.5 (0.5–4.3), <i>p</i> =0.5
Duration of hospital stay (days)	2.4±0.8	2.3±0.8	2.2 (0.3–22.6), <i>p</i> =0.5
Pelvic floor examination			
Intact perineum	54 (51)	41 (37)	0.5 (0.3–0.9), <i>p</i> =0.03
First- and second-degree tear	92 (87)	90 (80)	1.6 (0.7–3.2), <i>p</i> =0.3
Third-degree tear	3 (3)	3 (3)	0.9 (0.2–4.9), <i>p</i> =0.9
Fourth-degree tear	0	3 (3)	–

– Analysis not permissible due to insufficient numbers

postures even though there is little evidence to suggest that giving birth in a supine or semi-recumbent position is more beneficial for maternal outcome [2].

There were no significant differences in regard to obstetrical sphincter tears between the groups: there were, however, three cases of grade IV sphincter injury

in the sitting group compared to none in the kneeling group. Although not statistically significant, this observation was a cause for concern and may be related to the higher number of episiotomies performed in the sitting cohort. Overt or occult anal sphincter injury during vaginal delivery is a recognized risk factor for developing anal

Table 3 Covariate risk analysis of both upright groups combined

Variable	Multivariate analysis odds ratio (95% CI)
Association with maternal bleeding >500 ml	
Maternal age	1.0 (0.9–1.1), <i>p</i> =0.4
Maternal age categorized in 5-year intervals	0.8 (0.6–0.9), <i>p</i> =0.04
Fetal weight <4 kg	0.6 (0.3–1.1), <i>p</i> =0.1
Fetal weight >4 kg	2.0 (1.2–4.3), <i>p</i> =0.03
Second stage of labor >1 h	2.2 (1.1–4.2), <i>p</i> =0.02
Duration of labor >12 h	1.5 (0.8–2.8), <i>p</i> =0.2
Epidural anesthesia	1.0 (0.6–1.8), <i>p</i> =0.9
Labor augmentation with oxytocin	1.9 (1.1–3.4), <i>p</i> =0.03
Episiotomy	0.7 (0.2–2.3), <i>p</i> =0.6
Association with third- and fourth-degree sphincter tear	
Maternal age	1.1 (0.9–1.2), <i>p</i> =0.4
Maternal age categorized in 5-year intervals	0.9 (0.6–1.3), <i>p</i> =0.6
Fetal weight <4 kg	2.3 (0.3–19.4), <i>p</i> =0.4
Fetal weight >4 kg	0.7 (0.1–5.3), <i>p</i> =0.7
Duration of second stage of labor	1.2 (1.1–1.4), <i>p</i> =0.005
Total duration of labor >12 h	0.3 (0.1–2.2), <i>p</i> =0.2
Epidural anesthesia	0.5 (0.1–2.3), <i>p</i> =0.4
Labor augmentation with oxytocin	1.8 (0.4–7.4), <i>p</i> =0.4
Episiotomy	2.5 (1.1–4.5), <i>p</i> =0.02

incontinence [13–15] and there have been concerns over increased frequencies of perineal and sphincter lacerations after upright delivery positions [16].

The frequency of obstetrical sphincter tears in the present study was comparable to those in previously reported evaluations of various delivery postures [17–19]. Misclassification of perineal trauma is a potential weakness in the study design although it was unlikely to affect the overall outcome as it may have occurred in both groups. To evaluate uncommon complications such as grade IV obstetrical tears would require considerably larger study populations to ascertain statistical power in reasonable time, which would appear more appropriate for an observational study design. In contrast to Angioli et al. [20], there was no association between age at first delivery and anal sphincter laceration. As all subjects were nulliparous, we were unable to correlate obstetrical lacerations to parity, although this association has been confirmed by others [1].

Nulliparous women are at increased risk of undergoing episiotomy during delivery [21] even though the overall rate of episiotomies has decreased over the last decades [22, 23]. In the present trial, a sitting position was associated with more frequent episiotomies and consequently less subjects had an intact perineum. Compared to midline episiotomy, a mediolateral incision has been associated with a decreased risk of sphincter lacerations [24]; however, there is evidence suggesting that mediolateral episiotomies also substantially increase the risk of sphincter laceration during delivery [25]. In the present study, a mediolateral episiotomy was associated with grade III–IV obstetrical tears at logistic regression analysis; however, the number of sphincter tears were insufficient to allow for reliable data. Had the study been powered to detect a difference in this outcome measure, the trend towards a higher sphincter injury rate in the sitting group may have reached statistical significance and rates of associated perineal trauma may have also been more apparent.

One may speculate that the higher frequency of episiotomies performed in the sitting group was a consequence of the sitting position being associated with increased swelling and edema to the perineum. Sitting upright directs more straight pressure to the pelvic floor compared to kneeling, where the ability to modify position may vary the pressure axis to the pelvic floor, thus, reducing development of edema.

In contrast to Zetterstrom et al. [1], we found that prolonged duration of labor was associated with an increased risk of anal sphincter tears, an association which is plausible as prolonged labor may increase swelling and edema of the perineum, narrowing the birth canal and increasing perineal tensions at crowning. This association may have been even stronger if a number of prolonged deliveries had not been ended by the use of vacuum extraction or forceps, confounding the final analysis. These cases were, therefore, excluded from the risk analysis model. For unknown reasons, the number of

instrumental deliveries was proportionally higher in the sitting group compared to kneeling.

Fetal weight was not associated with an increased risk of sphincter injury. This differs from the conclusion of Christianson et al. [26]. Part of the explanation for this divergence may be found in the study design. Open cohort studies may be biased by factors that interact and affect the outcome, such as maternal disease, overmaturity, instrumental delivery, and various delivery positions. Testing our data in a multivariate logistic regression model attempted to adjust for such interactions and our risk analysis suggests that fetal birth weight might be of less importance for obstetrical sphincter lacerations in healthy primiparous subjects giving birth in upright positions.

There were no major maternal complications in either delivery group. We found no diversity in maternal bleeding at delivery and post-partum bleeding exceeding 1,000 ml was reported in approximately 7% of cases. An analysis of covariates indicated that duration of second stage of labor >1 h, fetal weight, and oxytocin-augmented contractions were associated with an increased risk of bleeding in excess of 500 ml. This association might be explained by the common feature of post-partum uterine laxity, due to muscle fatigue, resulting in larger maternal bleedings.

The homogenous population samples of the present study has both advantages and disadvantages. The two groups were comparable in pre-trial maternal characteristics; both cohorts had a rather low dropout rate and few patients declined to participate in the study when approached (6%). We believe that these traits minimized the risk of selection bias influencing the results while increasing the internal validity. The stringent inclusion criteria also limited the risk of confounders influencing the results, and causality between delivery posture and outcome may, therefore, be more reliable. The wide range of exclusion criteria may, however, hamper a generalization of our findings to a general population of primiparous women.

Conclusions

The main finding of the present study was that kneeling and sitting upright during labor were not associated with significant differences in anal sphincter lacerations. Besides an increased risk of sphincter laceration after prolonged duration of second stage of labor and episiotomy, we found no risk factors associated with grade III and IV obstetrical lacerations in normal, healthy women in upright delivery positions at full term.

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