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Title page

Prophylactic manual Rotation of Occiput POsterior and transverse Positions to decrease operative Delivery: The PROPOP Randomized Clinical Trial

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Condensation: Prophylactic manual rotation should be considered as a technique to deal with occiput posterior and transverse positions at the early second stage of labor.

Short title: Prophylactic manual rotation of occiput posterior and transverse positions

AJOG at a Glance:

A. **Why was this study conducted?** This multicenter randomized controlled trial was conducted to determine if the trial of prophylactic manual rotation at the early second stage of labor is associated with a decrease of operative deliveries (instrumental and/or cesarean deliveries).

B. **What are the key findings?** In women at early stage of labor with an occiput posterior and transverse positions, the trial of prophylactic manual rotation was significantly associated with decreasing risk of operative delivery. Women in the intervention group were more likely to have a significantly shorter second stage of labor.

C. **What does this study add to what is already known?** These findings support that the trial of prophylactic manual rotation could be considered as an effective technique to deal with occiput posterior and transverse positions at the early second stage of labor.

Abstract

Background: Persistent occiput posterior and occiput transverse positions are the commonest malpositions of the fetal head during labor and are associated with prolonged second stage of labor, cesarean sections, instrumental deliveries, severe perineal tears, postpartum hemorrhage and chorioamnionitis. Manual rotation is one of several strategies described to deal with these malpositions.

Objective: The purpose of this study was to determine if the trial of prophylactic manual rotation at the early second stage of labor is associated with a decrease of operative deliveries (instrumental and/or cesarean deliveries).

Study design: We conducted a multicenter, open-label, randomized controlled trial in four French hospitals. Women with singleton term pregnancy and occiput posterior or transverse position confirmed by ultrasound at the early second stage of labor and with epidural analgesia were eligible. Women were randomly assigned (1:1) to either undergo a trial of prophylactic manual rotation of occiput posterior or transverse position (intervention group) or no trial of prophylactic manual rotation (standard group). The primary outcome was operative delivery (instrumental and/or cesarean deliveries). Secondary outcomes were length of the second stage of labor, maternal complications (post-partum hemorrhage, operative complications during cesarean, episiotomy and perineal tears) and neonatal complications (Apgar score < 5 at 10 min, arterial umbilical pH < 7.10, neonatal injuries, neonatal intensive care unit admission). The main analysis was focus on intention-to-treat analysis.

Results: From December 2015 to December 2019, a total of 257 women (mean age, 30.4 years, mean gestational age, 40.1 weeks) were randomized: 126 assigned to the intervention group and 131 to the standard group. Operative delivery was significantly less frequent in

the intervention (I) group compared to the standard (S) group (29.4% [37/126] vs. 41.2% [54/131], p=.047, Differentiel (I-S) [95% confidence interval, CI] = -11.8 [-15.7;-7.9]; unadjusted odds ratio [95% CI] = 0.593 [0.353-0.995]). Women in the intervention group were more likely to have a significantly shorter second stage of labor.

Conclusions: Trial of prophylactic manual rotation of occiput posterior or transverse positions during the early second stage of labor was statistically associated with a reduced risk of operative delivery. This maneuver could be a safe prevention of operative delivery.

Keywords: cesarean delivery, fetal position, instrumental delivery, manual rotation, operative delivery, posterior position, second stage of labor, transverse position

Main Text

Introduction

Occiput posterior (OP) and transverse (OT) positions are the common fetal malpositions during labor with an estimated prevalence of 20% during labor, and approximately 5% of the fetuses remain in persistent OP position at delivery.[1–3] Several studies have shown that persistent OP position at delivery was significantly associated with longer labor, higher risks of operative vaginal deliveries, cesarean deliveries and severe perineal lacerations.[2–6] Various methods have been considered to promote rotation from a posterior or transverse to an anterior position.[7,8] Instrumental rotations with forceps, spatulas or a vacuum device are rarely used but contemporary studies have suggested that Kielland forceps, in experienced hands, could be an effective and safe method to deal with posterior position.[9–11] The learning curve of such method need to be evaluated. Over the last decades, studies have evaluated the efficacy of maternal posturing during labor to deal with the persistent OP and OT positions, without conclusive results.[12–17]

Several studies have reported manual rotation as a safe and simple technique to rotate the fetal head from a posterior or transverse to an anterior position, and two techniques have been described.[18–21] Existing literature has shown an association between this procedure and reducing risks of cesarean delivery and operative vaginal delivery, but only with low to moderate levels of evidence.[22–25] The trial of manual rotation at diagnosis of full dilatation, i.e. a prophylactic manual rotation, seems to be associated with higher chances of success of the maneuver, whereas rotation for failure to progress, i.e. a therapeutic manual rotation, with higher risks of failure.[22] Despite the moderate quality of evidence, the American College of Obstetricians and Gynecologists and the Society of Maternal-Fetal Medecine have issued

strong recommendations to consider manual rotation of the fetal head in the second stage of labor as a reasonable intervention before moving to operative or cesarean delivery.[26] This multicenter randomized clinical trial was conducted to determine the effect of trial of prophylactic manual rotation at the early second stage of labor on risks of operative delivery (instrumental and/or cesarean deliveries). It was hypothesized that in women at the early second stage of labor, a trial of prophylactic manual rotation would reduce operative deliveries compared with no trial of prophylactic manual rotation.

Materials and Methods

Ethical and Regulatory Issues

The ethics committee (Comité de Protection des Personnes Sud Méditerranée V), and the French National Agency for the Safety of Medecines and health products (Agence Nationale de Sécurité du Médicament et des Produits de Santé, ANSM) approved this trial on February 20, 2015 and July 10, 2015, and the trial was nationally registered (reference 2015-A00225-44). The ClinicalTrials.gov website was updated as soon as ethical and regulatory approvals were obtained. Each woman provided written informed consent prior to randomization.

Trial Design

This was an open-label, multicenter trial (4 centers in the South of France; 2 academic and 2 non-academic community hospitals) in which women were randomly assigned in a 1:1 ratio either to trial of prophylactic manual rotation of OP or OT position (intervention [I] group) or to no trial of prophylactic manual rotation (standard [S] group).

Patient selection

Women were eligible if they were aged at least 18 years, at least 37 weeks of gestation (WG) of a singleton pregnancy, at the early second stage of labor (at the diagnosis of full dilatation), with ruptured membranes, with a fetus in cephalic OP or OT position on physical exam and confirmed by ultrasound (defined in the pelvic horizontal plane as an angle < 90° between median line of brain and an anteriorposterior, virtual sacropubic line, with plan of orbits faced forwards), and with epidural analgesia. We chose to include only women with epidural analgesia to optimize the acceptability of the study because the trial of manual rotation could be a painful maneuver. Women with contraindications to vaginal delivery

(previous fourth-degree perineal tears or Crohn's disease with anal injury), sensitive perineum (bleeding perineum during vaginal examination), contraindication to operative vaginal delivery (such as known fetal hemostasis pathology or risk of fetal thrombopenia), non-reassuring fetal heart rate (FHR) with suspicion of fetal acidosis, known congenital fetal malformation, scarred uterus (risk factor of cesarean delivery), fetus in non-cephalic position, and without medical insurance were excluded.

We assumed that all eligible women were candidates for the trial of prophylactic manual rotation whatever the features of their pelvis.

Intervention allocation

Randomization was performed when the diagnosis of OP or OT position was given at the early second stage of labor. Participants were randomized either to trial of prophylactic manual rotation or to the standard group. A computer-generated randomization sequence was prepared by the study methodologist (KB) using blocks of 4, unknown to the investigators and stratified by center. A woman's assignment to a group was obtained from a secure website after a study number and confirmation of eligibility were entered and locked. The clinical care team could not be blinded to the intervention.

Trial interventions

Women in the intervention group had a trial of prophylactic manual rotation by the technique described by Tarnier and Chantreuil.[18] This technique was described on a mannequin during the implementation visit of the study in each center (Figure 1). All the co-investigators had to attend these training courses. The maneuver was attempted after sonographic confirmation of OP or OT position and of the fetal spine position. The woman,

bladder emptied, was placed in the lithotomy position, lying on her back with her feet in stirrups. When the uterus was relaxed, the trained operator placed one hand behind the fetal ear (right for left positions and left for right positions). During the uterine contraction, while the woman was pushing, the operator rotated the anterior fetal head by pressing on the hand, moving the occiput toward the anterior pelvic girdle. FHR was monitored continuously throughout these procedures and the fetal position was controlled by ultrasound immediately after the maneuver. In case of failure, the procedure could be repeated if the FHR was reassuring.

Women in the standard group had no trial of prophylactic manual rotation.

In France, and in these 4 centers, the common practices are to observe a passive second stage of labor and wait for the deepest engagement of the fetal head before pushing at full dilatation.

Outcome Measures and Data collection

The primary outcome was operative delivery (instrumental delivery and/or cesarean delivery). The indication of operative vaginal delivery, the type of instrument used, the position and station of the fetal head were noted. The indication of the cesarean delivery and the position of the fetal head during the cesarean were specified.

Secondary outcomes were length of the second stage of labor (from diagnosis of full dilatation to delivery), maternal complications such as post-partum hemorrhage (blood loss $\geq$ 500 mL), blood transfusion, maternal intensive care unit (ICU) admission, operative complications during cesarean, episiotomy, perineal tears and obstetrical anal sphincter injuries, and neonatal complications (Apgar score < 5 at 10 min, arterial umbilical pH < 7.10, neonatal trauma, and neonatal ICU admission).

Participants were monitored until discharge from the labor ward.

The women's demographics, antepartum, intrapartum, intraoperative, and postpartum course data were extracted from their medical record by research staff.

Sample size

During the ongoing study, we pursued our analysis of scientific literature and thanks to recent evidence,[17] we found that our previous sample size calculation (n=400) was not realistic or consistent with available data. The sample size was corrected by an amendment with a favorable opinion on May 9, 2019 (Comité de Protection des Personnes Sud Méditerranée V, ref 15.031). The original approved protocol and the approved amendment are available as Supplements 1 and 2.

Based on epidemiological data from prospective studies, the rate of operative delivery is 16% in case of delivery in occiput anterior position and 62% in case of persistent OP.[3,17,22,23,27,28] The sample size was calculated assuming that we expected a rate of operative delivery of 38% in the standard group, taking into account that in 60% of cases the OP would spontaneously turn to an anterior position during the second stage of labor.[17] In the intervention group, the expected rate of operative delivery was 22%, assuming that the maneuver would succeed in 9 cases of 10.[22]

To detect this 16-point difference between groups, with 80% power and the threshold for statistical significance set at a p-value of 0.05, assuming a potential 3% of patients were lost to follow-up, the amended sample size was 260 women needed. No interim analysis was planned.

Statistical analysis

Statistical analyses of this study were carried out in a blinded manner. The data were analyzed using SPSS version 20.0 software (SPSS Inc., Chicago, IL). Statistical significance was defined as $P < 0.05$. The methodology was based on the Consolidated Standards of Reporting Trials statement (CONSORT, http://www.consortstatement.org/consort-statement/). The intention-to-treat population was used in the primary analysis. For the primary outcome, the operative delivery rates were compared between groups (using χ^2 or Fisher's exact tests, two-tailed). The odds ratio (OR) with the 95% Confidence interval (CI) was provided. As a secondary analysis, the primary outcome was provided: 1) on the per protocol population; 2) after adjustment for parity (nulli- vs multiparous), for body mass index, and for the two parameters (logistic regression, enter method, adjusted ORs and Cis provided); 3) stratified by parity (nulli- vs multiparous). The secondary outcomes were compared between the 2 groups: using $\chi 2$ test or Fisher's exact test for binary variables; using Student's t-test or Mann-Whitney's test for continuous variables, as appropriate. There was no imputation of data (there was no missing data for the primary outcome and we observed less than 5% missing data for any variable).

Results

Study participants

From December 2015 to December 2019, a total of 1942 women were assessed for eligibility (screened for participation before confirmation by ultrasound). One hundred and fifty-six women did not meet the inclusion criteria at the last check before randomization, 852 women declined to participate and 677 were not randomized for other reasons (women not approached because physician was unavailable or missed by physician). Of the remaining 257 women, 126 were randomly assigned to trial of prophylactic manual rotation and 131 women to no trial of prophylactic manual rotation (Figure 2). No participants were lost to follow-up leaving 257 women included in the primary analysis. The mean age of participants was 30.4 (SD, 5.6) years and the mean body mass index was 26.8 (SD, 5.6). Participants included 71.6% nulliparous women, the mean gestational age was 40.1 (SD, 1.1) weeks, and 78.2% of participants had a spontaneous onset of labor. Baseline characteristics were well-balanced between the study groups (Table 1).

Primary Outcome

Operative delivery occurred in 37 women (29.4%) in the intervention group – trial of prophylactic manual rotation – and 54 women (41.2%) in the standard group (Table 2). The risk of operative delivery was significantly less frequent in the intervention (I) group compared to the standard (S) group (Differentiel (I-S) [95% confidence interval, CI] = -11.8 [-15.7;-7.9]; unadjusted odd ratio [95% CI] = 0.593 [0.353-0.995]). Instrumental delivery concerned 31 women (24.6%) in the intervention group and 45 women (34.4%) in the standard group. Cesarean delivery concerned 6 women (4.8%) in the intervention group and 9 women (6.9%) in the standard group.

In the per-protocol analysis, operative delivery occurred in 36/118 women (30.5%) in the intervention group and in 54/131 women (41.2%) in the standard group (*P*= .079). After logistic regression models, the intervention group remained significantly associated with less frequent operative delivery (parity: adjusted OR [95% CI] = 0.552 [0.317-0.962], *P*= .036; body mass index: adjusted OR [95% CI] = 0.587 [0.349-0.987], *P*= .045); parity and body mass index: adjusted OR [95%CI] = 0.547 [0.313-0.955]). After stratification by parity, the intervention group remained significantly associated with less frequent operative delivery for the subgroup of nulliparous patients (36,7% in the intervention group vs. 55.3% in the standard group, *P*= .011), but was not different for the subgroup of multiparous patients (11,1% in the intervention group vs. 5.4% in the standard group, *P*= .430).

Pre-specified Secondary Outcomes

The mean length of the second stage of labor was significantly shorter in the intervention group (intervention group: 146.7 min, standard group: 164.4 min; *P*= .028).

There were no significant differences between-groups in the risk of post-partum hemorrhage (OR, 1.363 [95% CI, 0.492 to 3.777]). No women were admitted to ICU. The risks of perineal tears, episiotomy, or obstetrical anal sphincter injury were not different between groups (Table 2). No cases of cervical laceration were noticed.

The mean Apgar score at 5 minutes was significantly higher for the neonates in the intervention group (intervention group: 9.8, standard group: 9.6; *P*=.049).

There were no significant differences in following neonatal outcomes: Apgar score < 5 at 10 minutes, and arterial umbilical pH < 7.10. No neonatal head trauma was noticed in either group.

Detailed characteristics of the trial of prophylactic manual rotation

In most cases, the fetuses were in right OP position controlled by ultrasound and the head station was between -2 and 0 before the trial of prophylactic manual rotation.

Ninety-five (88.8%) of the physicians performing the manual rotation were right-handed and physicians used their right hand in 54 (50.9 %) cases.

The success rate of prophylactic manual rotation was 89.7 % in the immediate moment of the procedure. The successful manual rotations resulted in a spontaneous vaginal delivery in 76.0% of cases.

Fetal heart rate abnormalities (repetitive decelerations) occurred in 22 (17.5%) cases after the trial of prophylactic manual rotation but without indication of emergency delivery.

Additional data

Among women delivering vaginally (operative or spontaneous vaginal deliveries), 116 (96.7%) women delivered in occiput anterior position in the intervention group versus 106 (86.9%) in the standard group (*P*= .009).

In the standard group, 28 (21.4%) women had an attempted therapeutic manual rotation secondarily after the randomization because of non-reassuring fetal heart rate or failure of progression of the fetal head. This procedure succeeded in 23 (82.1%) cases.

Discussion

Principal findings

This multicenter randomized clinical trial on women with a fetus in cephalic OP or OT position confirmed by ultrasound showed a significant reduction in operative delivery with the trial of prophylactic manual rotation at the early second stage of labor. Furthermore, the trial of prophylactic manual rotation was associated with a shorter length of second stage of labor.

Results in context

This randomized controlled trial (RCT) concerned the interest of prophylactic manual rotation and showed positive results.

To our knowledge, one pilot RCT was published as a feasibility study and it included 30 women.[29] The results of that study showed neither statistical significance nor a trend with regards to mode of delivery or maternal outcomes. The rates of operative delivery were particularly high (80 to 87%) in the study as were the rates of neonatal ICU admission (20 to 40%). Very recently, the same team has published the results of the trial following this pilot study.[30] In this RCT involving 254 women, the rates of operative delivery were also high (62 to 71%) as well as the rates of serious adverse neonatal outcomes (17%).

Another RCT (n= 65 women) has been reported as an abstract but the corresponding detailed results have not been published and the abstract reported no difference in operative vaginal delivery.[31]

Two others RCT have been registered at clinicaltrials.gov and should probably be published soon.[32–34]

The present study deals with prophylactic manual rotation at the early second stage of labor. We chose to study prophylactic manual rotation at this stage rather than therapeutic manual

rotation because literature has shown that attempted rotation before full dilatation and rotation for failure to progress, are two major risk factors for failure of the procedure.[22,35] The success rate of prophylactic manual rotation was as expected for the calculation of the sample size, and congruent with data in literature.[22,25] This high success rate (89.7%) could be related to the previously cited obstetrical factors and also to the systematic use of ultrasound before the procedure. Indeed, the sonographic evaluation of the fetal spine position has been shown to be associated with the success of the manual rotation.[36] The success rate we reported was higher than shown in the previously cited RCT.[29,30] This could be explained by the time of the randomization in these studies "at the first urge to push or one hour after full dilatation".

Thus, the technique of manual rotation as described by Tarnier and Chantreuil may be an efficient procedure to deal with OP and OT positions.

Our study confirmed the association of trial of prophylactic manual rotation with a shorter second stage of labor as previously reported.[24,31] The differential in the length of labor (18 min) seemed clinically relevant to us.

Contrary to the retrospective study of Shaffer *et al*., we did not find an association between trial of prophylactic manual rotation and the outcomes of perineal tears, episiotomy and obstetrical anal sphincter injuries.[24] The rate of episiotomy was higher than mean national rate of episiotomy in France (20.1% in 2016)[37] but lower than reported in previous studies (44 to 65%).[22,23] Furthermore, fetal heart rate abnormalities occurring after the trial of prophylactic manual rotation were not indications for emergency delivery. Our trial did not report any cases of cord prolapse, described as a complication of the maneuver in a former study.[19] Therefore, the trial of prophylactic manual rotation seemed to be a safe procedure at the maternal and the neonatal sides.

Furthermore, choosing a trial of prophylactic rather than therapeutic manual rotation could be the most effective strategy to deal with the OP and OT positions. One could argue that prophylactic manual rotation is more likely to have been unnecessary, as most posterior position will rotate spontaneously. However, significantly more women delivered in occiput anterior position in the prophylactic manual rotation in comparison with the standard group. Furthermore, in the standard group of our trial, a therapeutic manual rotation was subsequently performed in cases of non-reassuring fetal heart rate or failure of progression of the fetal head, but with a lower success rate.

Therefore, in cases of OP or OT positions, the trial of prophylactic manual rotation could be a safe and efficient procedure and with a small number needed to treat of 9 women.

Strengths and limitations

The present study has a number of strengths. Beyond the randomization allowing for a comparison of the efficacy of two strategies with the highest level of evidence, we had no loss to follow-up as the primary outcome was operative delivery which occurred within a few hours after randomization. Indeed, the intention-to-treat analysis could have been performed on primary outcome for all cases without missing data. Furthermore, an ultrasound scan was performed before randomization and at each stage of the follow-up, ensuring an objective and certain diagnosis of the fetal head position. This point ensured the reliability of diagnosis of the fetal head position because of the documented risks of errors in digital examination.[38–40]

This trial was performed in 4 maternity units with different volumes of activity and levels of care (secondary and tertiary care units) suggesting the applicability of the results of this trial elsewhere. The non-inclusion of pregnant women without medical insurance (according to

French law) did not reduce the representativeness of our results since a vast majority of people have medical insurance in France.

This study has several limitations. First, this study was not double-blinded. However, we do not believe that there could be a placebo effect on the women with this kind of procedure, and the clinical team could not feasibly be blinded to the intervention. We acknowledge the possibility that delivering physicians may have been influenced in their decisions by knowledge of the randomization group.

Second, we faced the usual difficulties of clinical research during labor with low rates of consent, and 852 out of 1942 women declined participation in the trial. This rate raises questions of external validity.

Third, the design of the follow-up did not allow exploration of long-term consequences. Occiput posterior deliveries are known to be associated with perineal morbidity and pelvic floor dysfunction at 6 months postpartum.[41] Therefore, future research about manual rotation should study these outcomes.

Fourth, the study was underpowered for each component of the primary outcome (instrumental vaginal delivery and cesarean delivery) and important secondary outcomes like neonatal morbidity and maternal morbidity (postpartum hemorrhage particularly). The generalizability of our results could be questionable since we reported a high frequency of instrumental vaginal delivery and notable cultural differences are reported in obstetrical practices.

Fifth, the satisfaction of the women was not studied. Nowadays, evaluation of the maternal childbirth experience is essential in obstetrics research. So, we plan to study maternal satisfaction in further studies about manual rotation.

Conclusions

Among women presenting an OP or OT position at the early second stage of labor, the trial of prophylactic manual rotation was significantly associated with less risk of operative delivery. These findings support that the prophylactic manual rotation should be consider as an effective and safe procedure to deal with OP or OT positions of the fetal head.

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Authors contributions: Drs Blanc and Baumstarck had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Concept and design: Blanc, Haumonté, D'Ercole

Acquisition, analysis, or interpretation of data: Blanc, Castel, Mauviel, Baumstarck, Bretelle, Haumonté, D'Ercole

Drafting of the manuscript: Blanc, Castel, Baumstarck

Critical revision of the manuscript: Mauviel, Bretelle, Haumonté, D'Ercole

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Data Sharing Statement: see Supplement 3

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547 **Tables**

548 Table 1. Baseline participant characteristics

Characteristics	No. (%) of women	
	Intervention (Trial of prophylactic manual rotation) (n=126)	**Standard (No trial of prophylactic manual rotation) (n=131)**
Age, mean (SD), y	30.2 (5.6)	30.5 (5.6)
Nulliparous	90 (71.4)	94 (71.8)
Body Mass Index, mean (SD), kg/m^2	28.5 (5.7)	28.7 (5.4)
Gestational age, mean (SD), w	40.0 (1.1)	40.1 (1.0)
Anterior position of placenta	71 (58.2)	65 (51.6)
Gestational diabetes	19 (15.2)	18 (13.7)
Suspected macrosomia[a]	9 (7.1)	4 (3.1)
Spontaneous onset of labor	101 (80.2)	100 (76.3)
Oxytocin administration	95 (75.4)	109 (83.2)

during labor		
Length of active phase of labor (from 6 cm to full dilatation), mean (SD), min	187.8 (105.7)	206.1 (116.9)
Cervical dilatation at diagnosis of posterior position, mean (SD), cm	7.9 (2.0)	7.8 (1.9)
Non reassuring fetal heart rate before full dilatation[b]	40 (31.7)	50 (38.5)
Postural strategies to deal with posterior position during labor[c]	37 (30.1)	41 (31.8)
Birthweight, mean (SD), grams	3433.5 (409.0)	3424.6 (466.6)

549 Data are expressed as mean (SD) or number (percentage)

550 [a] Estimated fetal weight above the 95th percentile in a third trimester ultrasound

551 [b] Suspicious cardiotocography (FIGO 2015 classification)

552 [c] women adopting postures that differed from dorsal recumbent position during labor

553 Table 2. Primary and Secondary Outcomes by randomization group

	Intervention group Trial of prophylactic manual rotation (n=126)	**Standard group No trial of prophylactic manual rotation (n=131)**	**Odds Ratio (95% CI)**	***P* value**
Primary outcome				
Operative delivery, No. (%)	37 (29.4)	54 (41.2)	0.593 (0.353-0.995)	.047
Primary outcome components				
Instrumental delivery, No. (%)	31 (24.6)	45 (34.4)	0.624 (0.362-1.073)	.087
Cesarean delivery, No. (%)	6 (4.8)	9 (6.9)	0.678 (0.234-1.963)	.471
Prespecified secondary outcomes				
Length of second stage of labor in minutes, mean (SD)	146.7 (64.4)	164.4 (58.2)		.028

Post partum hemorrhage, No. (%)	9 (7.1)	7 (5.3)	1.363 (0.492-3.777)	.551
Perineal tears, No. (%)	92 (73.0)	96 (73.8)	0.958 (0.550-1.669)	.880
Obstetrical Anal Sphincter Injury, No. (%)	4 (4.7)	4 (4.7)		>.99
Episiotomy, No. (%)	24 (26.1)	27 (28.1)	0.902 (0.474-1.717)	.753
Apgar score at 5 minutes	9.8 (0.7)	9.6 (1.0)		.049
Apgar score < 5 at 10 minutes, No. (%)	0	1 (0.8)		> .99
Arterial umbilical pH < 7.10, No. (%)	5 (4.0)	4 (3.1)	3.803 (0.419-34,531)	.235
Neonatal Intensive Care Unit Admission, No. (%)	1 (0.8)	4 (3.1)		.371

554 CI, Confidence Interval; SD, Standard Deviation

555 **Figure legends**

556 Figure 1. Technique of manual rotation described by Tarnier and Chantreuil

557 Figure 2. Randomization and follow-up of study participants

Figure 1. Technique of manual rotation described by Tarnier and Chantreuil
The woman, bladder emptied, was placed in the lithotomy position, lying on her back with her feet in stirrups. When the uterus was relaxed, the trained operator placed one hand behind the fetal ear (right for left positions and left for right positions). During the uterine contraction, while the woman was pushing, the operator rotated the anterior fetal head by pressing on the hand, moving the occiput toward the anterior pelvic girdle.

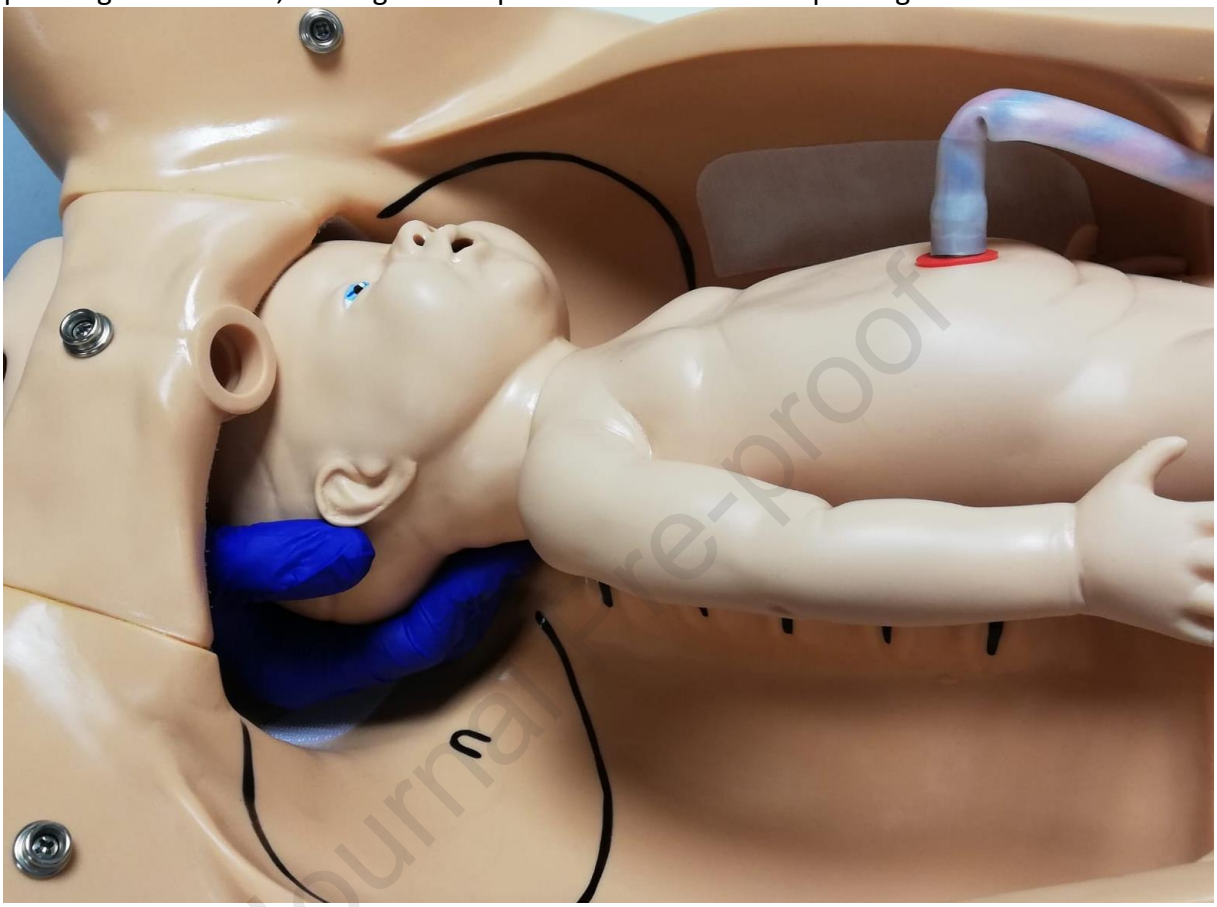
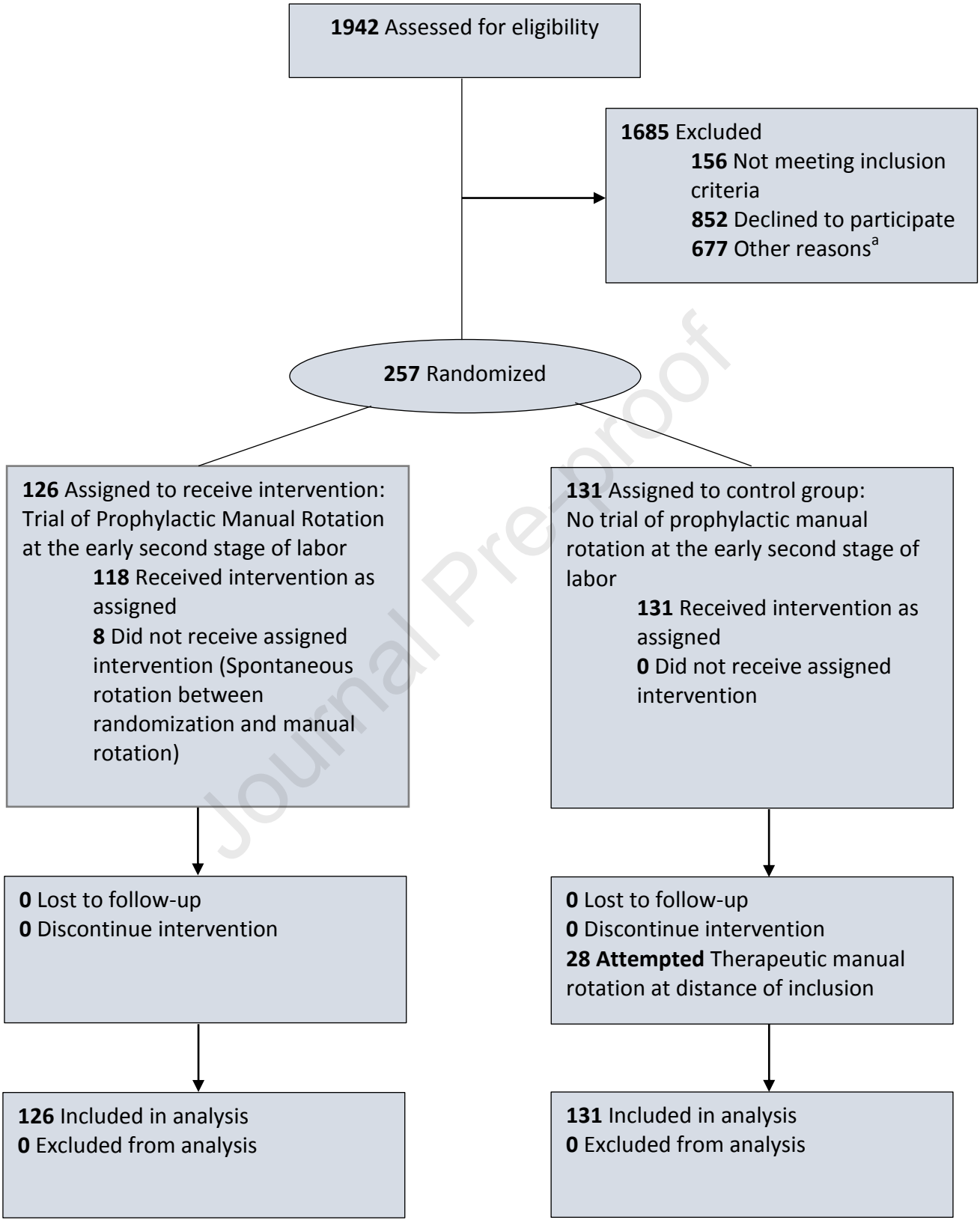


Figure 2. Randomization and follow-up of study participants



[a] Other reasons were women not approached because physician were unavailable or missed by physician