Hands-and-knees posturing and fetal occiput anterior position: a systematic review and meta-analysis

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OBJECTIVE: Persistent occiput posterior and occiput transverse positions are associated with adverse maternal and neonatal outcomes. The objective of this study was to assess if the use of hands-and-knees posturing increased the rate of occiput anterior position immediately after posturing during the second stage of labor or at the time of birth.

DATA SOURCES: An electronic search of PubMed, EMBASE, Clinicaltrials.gov, and Cochrane Central Register of Controlled Trials was performed from inception to September 2020.

STUDY ELIGIBILITY CRITERIA: Eligibility criteria included all randomized controlled trials of singleton gestations at ≥36 weeks' gestation that were randomized to either the hands-and-knees posture group or control group. The primary outcome was a composite of occiput anterior positioning during the second stage of labor or at birth. Individual components of the composite were assessed as secondary outcomes. Additional secondary outcomes were a change to occiput anterior position immediately after the intervention, use of regional anesthesia, duration of labor, mode of delivery, third- or fourth-degree perineal laceration, neonatal birthweight, and Apgar score less than 7 at 5 minutes.

METHODS: The methodological quality of all the included studies was evaluated using the Cochrane Handbook for Systematic Reviews of Interventions. A meta-analysis was performed using the random effects model of DerSimmonian and Laird to produce a summary of the treatment effects in terms of relative risk or mean difference with 95% confidence intervals.

RESULTS: Of the 1079 studies screened, 5 met the inclusion criteria (n=1727 hands-and-knees posture vs n=1641 controls). When compared with the control group, patients who adopted the hands-and-knees posture had the same rate of occiput anterior positioning in the second stage of labor or at birth (81.2% vs 81.2%; relative risk, 1.03; 95% confidence interval, 0.92−1.14), as well as immediately after the intervention (34.1% vs 18.0%; relative risk, 1.60; 95% confidence interval, 0.88−2.90). On the basis of the post hoc subgroup analysis of patients with an ultrasound-diagnosed malposition before posturing, there was a higher rate of occiput anterior positioning immediately after the intervention (17.0% vs 10.3%; relative risk, 1.63; 95% confidence interval, 1.06−2.52), but this relationship did not persist at delivery. The remainder of the subgroup analyses and secondary outcomes were not significant.

CONCLUSION: Adopting a hands-and-knees posture does not increase the rate of occiput anterior positioning at time of delivery.

Key words: fetal head position, hands-and-knees, maternal posture, occiput anterior, occiput posterior, occiput transverse

Introduction

The occiput posterior (OP) and occiput transverse (OT) positions are the most common fetal malpositions occurring in 30% to 50% of fetuses at term and in 5% to 8% of neonates at delivery.[1−5] The risk factors for malpositioning include nulliparity, a neonatal birthweight of >4000 g, augmentation of

Cite this article as: Levy AT, Weingarten S, Ali A, et al. Hands-and-knees posturing and fetal occiput anterior position: a systematic review and meta-analysis. Am J Obstet Gynecol MFM 2021;3:100346.

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Received February 16, 2021; accepted March 4, 2021.

The authors report no conflict of interest.

This abstract was presented as a poster at the 41st annual pregnancy meeting of the Society for Maternal-Fetal Medicine, Las Vegas, NV, January 23−30, 2021.

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2589-9333/$36.00

http://dx.doi.org/10.1016/j.ajogmf.2021.100346

AJOG MFM at a Glance

Why was this study conducted?

We aimed to assess if the use of hands-and-knees posturing affected the rate of occiput anterior (OA) positioning after posturing in the second stage of labor or at the time of birth.

Key findings

The rate of OA positioning after the initial intervention during the second stage of labor or at birth was the same for patients who adopted the hands-and-knees posture compared with the controls. In the subgroup of patients with an ultrasound-diagnosed malpositioning, hands-and-knees posturing caused an increasing in the rate of OA positioning immediately after intervention, but this relationship did not persist at time of delivery. There were also no differences in any of the maternal or neonatal secondary outcomes.

What does this add to what is known?

Our study suggests that the use of hands-and-knees posturing only promotes short-term fetal head rotation to the OA position in patients with an ultrasound-diagnosed malposition. In all patients, the use of posturing does not affect the rate of OA positioning at delivery.

labor, and obesity.[6] Persistent OP and OT positions are associated with a prolonged duration of labor, higher rates of operative vaginal and cesarean deliveries, as well as an increased incidence of 5-minute Apgar scores less than 7, umbilical artery acidemia, and neonatal intensive care unit admissions.[7–9] Therefore, prevention or treatment of a persistent OP or OT position could improve the maternal and perinatal outcomes.

Controversy exists regarding the optimal approach to correct malpositioning of the fetal head during labor. Interventions used by healthcare providers in pregnancies with fetal malpositioning include maternal posturing, manual rotation, operative vaginal delivery, and cesarean delivery. Posturing techniques do not require invasive manipulation or instrumentation and are generally considered low-risk interventions. Several randomized controlled trials (RCTs) have looked at the effect of maternal posturing on fetal malpositioning. Specifically, by changing the shape and angle of the uterus, hands-and-knees posturing has been proposed as a method to prevent and treat OP or OT positioning during labor.[10,11] A Cochrane review from 2007 that included only 1 study concluded that there was inadequate evidence to recommend this intervention.[12] However, since this publication, additional RCTs that assessed the efficacy of maternal hands-and-knees posturing for the management of fetal head malpositioning have been published.[13,14]

The objective of this review was to assess the effect of the hands-and-knees posture on the rate of occiput anterior (OA) positioning immediately after posturing during the second stage of labor and at birth.

Materials and Methods

Search strategy and information sources

This systematic review and meta-analysis was performed according to the Preferred Reporting Item for Systematic Reviews and Meta-Analyses Statement.[15] Before data collection, the research protocol was established and the review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42020209312).

One author (A.L.), with the aid of a trained medical librarian, performed an electronic search in PubMed, EMBASE, Clinicaltrials.gov, and Cochrane Central Register of Controlled Trials from inception to September 2020. Our search strategy included a combination of keywords including, or related to, "hands-and-knees," "occiput posterior," and "occiput transverse" (Appendix). No restrictions in terms of language or geographic location were applied. The reference lists of all the reviewed articles were evaluated for additional studies that met the inclusion criteria. The full database search query is available on request.

Study selection

Two of the authors (A.L. and A.A.) independently screened all the abstracts. The full text manuscript of the studies deemed relevant were then reviewed. The eligibility criteria included all RCTs of singleton gestations at ≥36 weeks' gestation that were randomized to either the hands-and-knees posture group or control group (ie, any posture other than the hands-and-knees posture) that reported the outcome data for the fetal head position. Studies in which the intervention group used a combination of postures (ie, hands-and-knees in combination with other postures) were excluded. Observational, noncontrolled, and quasi-randomized trials were also excluded. Any disagreements between the reviewers were resolved with a discussion involving a third author (J.Q.N.).

Risk of bias

The risk of bias of each included study was assessed using the criteria suggested in the Cochrane Handbook for Systematic Reviews of Interventions.[16] This guideline uses the following 7 domains to evaluate the risk of bias: (1) random sequence generation; (2) allocation concealment; (3) blinding of participants and personnel; (4) blinding of outcome assessment; (5) incomplete outcome data; (6) selective reporting; (7) other bias. Two reviewers (A.L. and S.W.) individually assessed the risk of bias for each of the domains and categorized the study as "low," "high," or "unclear" in terms of the risk of bias. The overall risk of bias for each included study was deemed "low," "moderate," or "high." Any disagreements between the reviewers were resolved via discussion involving a third author (J.Q.N.).

Data extraction and outcomes

The data were extracted from the included studies independently by 2 authors (A.L. and A.A.) and were validated by a third author (S.W.). The following data were recorded without modification: study characteristics (authors, year of publication, location, sample size, and inclusion and exclusion criteria); method of diagnosing the fetal position (ie, palpation or ultrasound); labor status at randomization (ie, spontaneous or induced labor, intact or ruptured amniotic membranes); patient demographics (age, body mass index, height, nulliparity, gestational age at enrollment); description and duration of the hands-and-knees posture intervention; postures adopted by the control group; delivery details; and neonatal outcomes. When information was missing for an included study, the corresponding author was contacted directly to request the unpublished data.

The primary outcome was a composite of OA positioning during the second stage of labor or at birth after adoption of the hands-and-knees posture as defined in the individual RCTs. Each component of the composite was also assessed as an individual outcome. The following additional secondary outcomes were included: OA position immediately after the hands-and-knees posture intervention (before labor or during the first stage of labor); use of regional anesthesia; duration of the first stage of labor, duration of the second stage of labor, and total duration of labor; mode of delivery (vaginal, operative, or cesarean delivery); rate of third- or fourth-degree perineal laceration; neonatal birthweight; and Apgar score less than 7 at 5 minutes.

Prespecified subgroup analyses for patients in labor and for patients not in labor at the time of posturing were performed for the primary outcome and for change to the OA position after the initial intervention. In addition, post hoc subgroup analyses for the same outcomes were performed to investigate the effect of the following 3 areas of study design heterogeneity: mode of diagnosis of malpositioning before posturing (ultrasound-diagnosed), indication for posturing (prevention of malpositioning and treatment of malpositioning), and duration of posturing (more than 30 minutes).

Statistical analysis

The data were analyzed using Review Manager 5.3.5 (The Nordic Cochrane Center, 2014, Copenhagen, Denmark) and Stata statistical software package (version 16.1, StataCorp. 2019, College Station, TX). The baseline demographics and intervention details for each study were combined and summarized using descriptive statistics. Continuous data from the individual studies were totaled using the algorithm described in the Cochrane Handbook for Systematic Reviews.[16] To facilitate the comparison across studies, the outcomes presented as the median with an interquartile range were converted to mean ± standard deviation. Within the pooled data, baseline differences between the groups were assessed using chi-square and *t* tests as appropriate. A *P* value of <.05 was considered statistically significant.

A meta-analysis was performed if the data were available in at least 2 studies. We calculated the pooled relative risk (RR) and mean difference with the associated 95% confidence interval (CI) for the categorical and continuous outcome data, respectively. A meta-analysis was performed using the random effects model of DerSimmonian and Laird. Study heterogeneity was measured using Higgins I^2 statistics. It was planned that possible publication biases would be assessed statistically with Begg's and Egger's tests and graphically using funnel plots if more than 10 studies were included.

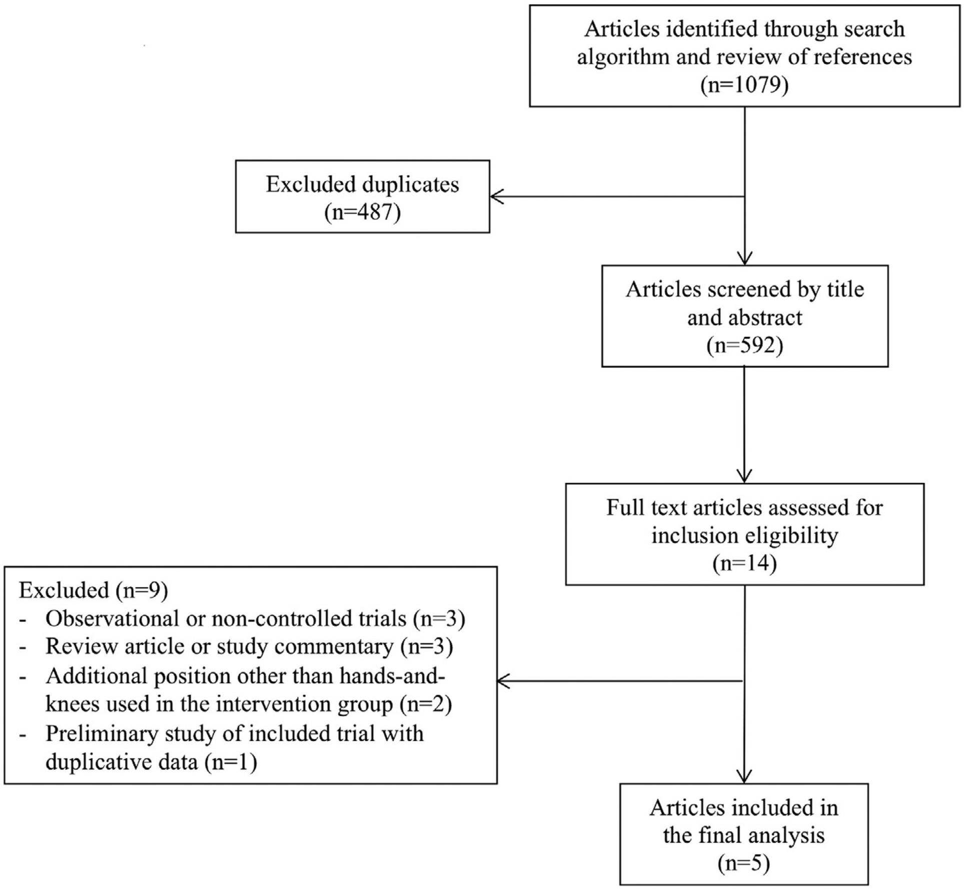
Results

Study selection and study characteristics

Of the 1079 studies identified using the search strategy, 14 were reviewed for inclusion (Figure 1). Details for the 9 excluded publications[12,17–24] are shown in Supplemental Table 1. Reasons for exclusion were noncontrolled trial or observational study designs,[17–19] review article,[12,22,23] use of additional postures other than hands-and-knees posturing as part of the intervention,[20,24] and duplicated data from the preliminary study of an included trial.[21] Our original PROSPERO registration stated that we would include studies of women who were ≥37 weeks' gestation. Following review of the studies for possible inclusion, we found a large trial that enrolled women beginning at 36 weeks' gestation, however, the use of posturing did not occur until they were at least at 37 weeks' gestation.[25] Our PROSPERO registration was amended to reflect this change to include this trial and, thus, a total of 5 trials met the eligibility criteria for inclusion in this review.[10,13,14,25,26] These 5 trials included 3368 patients: 1727 in the hands-and-knees group and 1641 in the control group. Four authors[13,14,25,26] responded to our attempt to obtain unpublished data; 2 authors[13,26] were able to provide the requested information.

Characteristics of the 5 trials are presented in Table 1. The included studies were performed in 7 different countries and were published between 1983 and 2016. All of the studies were RCTs that compared the hands-and-knees posture with a control and all included patients that were ≥36 weeks' gestation. One trial included 4 variations of the hands-and-knees posture and randomized participants to these 4 postures and the control.[10] In 4 of the trials,[10,13,14,26] the fetus had to be in the OP or OT position before randomization to be included. The 1 trial (n=2547) in which malpositioning was not required for inclusion aimed to assess the utility of hands-and-knees posturing to prevent OP positioning at birth.[25] The mode of assessing fetal malpositioning differed between studies: 1 trial[10] used Leopold's maneuver; 2 trials[14,26] used ultrasound assessment; 1 trial[13] used palpation for the initial assessment and either palpation or ultrasound after the intervention; 1 trial[25] did not specify how fetal malpositioning was diagnosed. Three trials[13,14,26] assessed patients who were in labor and 2 trials[10,25] assessed patients who were not yet in labor. The duration of the intervention in the

FIGURE 1
Flow diagram showing the process for study inclusion



Flow diagram of studies identified in the meta-analysis according to the PRISMA statement.

PRISMA, preferred reporting items for systematic reviews and meta-analyses.

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studies varied from 10 to 60 minutes. In the 3 studies using hands-and-knees posturing during labor, the patients were permitted to adopt the posture of their choosing after the initial intervention period until they delivered. For the control groups, 2 studies allowed participants to use any posture other than the hands-and-knees posture[14,26] and 3 studies assigned a specific posture or movement (ie, lateral decubitus, sitting, or walking).[10,13,25]

The patient demographics at enrollment for the included trials are shown in Table 2. Within the pooled data, the only baseline differences between the groups were nulliparity (58.1% hands-and-knees posture vs 55.7% controls; P=.03) and gestational age (in weeks) at enrollment (39.7±1.1 hands-and-knees posture vs 39.4±2.2 controls; P=.04). Posturing details for the included studies are shown in Supplemental Table 2. Data on the duration of posturing for the intervention group and on elective use of hands-and-knees posturing after the study period was available in 3 trials.[13,14,26] Among these studies, 2 trials found that at least 80% of the patients in the intervention group maintained hands-and-knees posturing for more than 30 minutes.[13,26] On the basis of the pooled analysis, the control group was more likely to electively choose to use hands-and-knees posturing after the study period than the intervention group (26.4% hands-and-knees posture vs 52.4% controls; P<.01).

Study quality and risk of bias

Four trials[13,14,25,26] mentioned receiving institutional review board approval, but only 1[14] study discussed registration with a World Health Organization accredited registry before study initiation. The overall bias for the included studies were mostly low risk, with 2 of the studies[10,13] deemed to be at moderate risk of bias (Figure 2). The majority of the trials had a low risk of bias in "random sequence generation" and "allocation concealment." One trial did not provide adequate detail regarding randomization and allocation of participants.[10] For all the studies, blinding of the participants and all personal was not possible because of the nature of the intervention. With regard to "blinding

TABLE 1
Included study details

Authors	Andrews et al[10]	Kariminia et al[25]	Stremler et al[26]	Molina Reyes et al[13]	Guittier et al[14]
Year of publication	1983	2004	2005	2014	2016
Location	US	Australia	US, Israel, England, Australia, Argentina	Spain	Switzerland
Sample size (intervention vs control)	100 (80 vs 20)	2547 (1292 vs 1255)	147 (70 vs 77)	135 (65 vs 70)	439 (220 vs 219)
Inclusion criteria					
Gestational age (wk)	≥38	≥36	≥37	≥37	≥37
Labor status	Not in labor (intact amniotic membranes)	Not in labor	Early or active labor	Active labor	Early or active labor (cervical dilation: 2–9 cm)
Fetal head positioning	OP or OT	NR	OP	OP	OP
Exclusion criteria	History of CD or other uterine surgery; condition associated with or evidence of polyhydramnios; multifetal gestation; transverse lie	Planned cesarean delivery	Contraindication to hands-and-knees posture; second stage of labor expected within 1 hour; planned cesarean delivery; known major fetal congenital anomalies	Maternal conditions that prevented hands-and-knees posture; indicated cesarean delivery; multifetal gestation	Nonfluent French speaking; previously used hands-and-knees posture during first stage of labor
Mode of diagnosing fetal malposition	Leopold's maneuvers	NR[a]	Ultrasound	Palpation	Ultrasound
Mode of evaluating fetal position after intervention	Leopold's maneuvers	NR[a]	Ultrasound	Palpation or ultrasound	Ultrasound
Description of hands-and-knees posture	Four variations[b] of hands-and-knees posturing for 10 min	Hands-and-knees posturing with pelvic rocking for 10 min twice per day starting at 37 wks' gestation until labor	Hands-and-knees posturing for at least 30 min and up to 60 min. After 60 min, patient could use any posture they wanted until delivery	Hands-and-knees posturing for at least 30 min. After 30 min, patient could use any posture they wanted until delivery	6 variations[c] of hands-and-knees posturing for at least 10 min, up to 60 min. After 60 min, patient could use any posture they wanted until delivery
Control group	Sitting in a chair	Daily walking	Any posture other than hands-and-knees posturing	Lateral decubitus. After 30 min, could assume any posture (including hands-and-knees posturing) until delivery	Any posture other than hands-and-knees posturing. After 60 min, could assume any posture (including hands-and-knees posturing) until delivery
Primary outcome	Fetal head position after 10 min	Fetal head position at birth[d]	Fetal head position after 60 min	Fetal head position after 30 min	Fetal head position after 60 min or at delivery
Secondary outcomes	Fetal position after second posture in patients with persistent OP	Induction of labor, use of epidural, mode of delivery, duration of labor, episiotomy, Apgar score	Fetal head position at delivery, persistent back pain, operative delivery, perineal trauma, Apgar score, length of labor, patient attitudes toward posturing	Mode of delivery, duration of intervention, and duration of labor	Comfort with postures, pain, duration of first and second stage, mode of delivery, perineal status, markers of neonatal asphyxia

Data are expressed as total N (n of intervention group vs n of control group).

CD, cesarean delivery; *NR*, not recorded; *OP*, occiput posterior; *OT*, occiput transverse.

[a] Fetal position was not evaluated before enrollment or after intervention;; [b] Four variations of the posture combined for purpose of this study. Variations included hands-and-knees posture alone, hands-and-knees posture with pelvic rocking, hands-and-knees posture with stroking of the abdomen, and hands-and-knees posture with pelvic rocking and stroking of the abdomen;; [c] Six variations of the posture combined for purpose of this study;; [d] OP position at vaginal delivery, OP position at cesarean delivery, or requirement for manual or instrumented rotation.

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TABLE 2
Baseline demographics and characteristics at enrollment

	Andrews et al,[10] 1983[a]	Kariminia et al,[25] 2004	Stremler et al,[26] 2005	Molina Reyes et al,[13] 2014	Guittier et al,[14] 2016	Total[b]	P value
Age (y)	26.3±4.1	28.6±5.1 vs 28.3±5.3	28.9±6.2 vs 27.4±5.8	28.4±5.2 vs 30.5±6.0	30.5±4.8 vs 30.0±4.8	28.9±5.2 vs 28.6±5.3	.10
BMI (kg/m²)	NR	25.5±11.4 vs 25.6±11.7	NR	NR	NR	25.5±11.4 vs 25.6±11.7	.83
Height (cm)	62.7±25	NR	NR	NR	164.8±6.6 vs 164.6±6.3	164.8±6.6 vs 164.6±6.3	.75
Nulliparous	41/100 (41)	716/1292 (56) vs 675/1255 (54)	44/70 (63) vs 48/77 (62)	49/65 (75.4) vs 39/70 (55.7)	148/220 (67.3) vs 141/219 (64.4)	957/1647 (58.1) vs 903/1621 (55.7)	.03
Gestational age at enrollment (wks)	NR	NR	39.8±1.2[c]	40.1±1.3 vs 39.5±3.8	39.6±1.0 vs 39.4±1.3	39.7±1.1 vs 39.4±2.2	.04
Spontaneous labor at time of intervention	0/100 (0)	0/1292 (0) vs 0/1255 (0)	59/70 (84) vs 56/77 (73)	36/65 (55.4) vs 30/70 (42.9)	81/220 (36.8) vs 78/219 (35.8)	176/1647 (10.7) vs 164/1621 (10.1)	.59
Amniotic sac intact at time of intervention	100/100 (100)	NR	40/70 (57) vs 32/77 (42)	8/65 (12.3) vs 5/70 (7.1)	25/220 (11.4) vs 32/219 (14.6)	73/355 (20.6) vs 69/366 (18.9)	.56

Data are expressed as mean ± standard deviation or n/N (%) for intervention vs control unless otherwise specified.

BMI, body mass index; *NR*, not recorded.

[a] Baseline demographics shown are the averages for the entire study group. Data about the intervention vs control group were not reported; [b] Total calculated using study data provided as intervention vs control. When groups were combined and averages were provided, the data were omitted from the total calculation; [c] Gestational age only available as the average of entire study group——17/70 (24%) and 16/77 (21%) of patients in the intervention and control group, respectively, were ≥41 weeks' gestation at the time of randomization.

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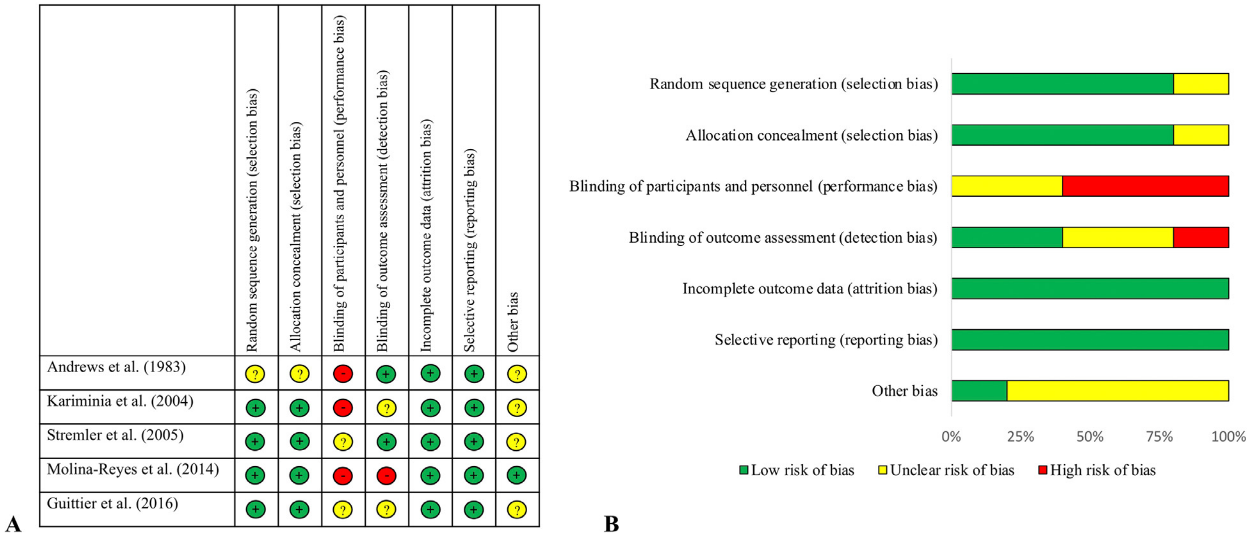
FIGURE 2
Assessment of risk of bias



A, Risk of bias for each trial. The *plus sign* indicates a low risk of bias, a *question mark* indicates an unclear risk of bias, and the *minus sign* indicates a high risk of bias. **B,** Risk of bias items presented as percentages across all the included studies.

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of outcome assessment," bias was deemed to be low risk in 2 trials,[10,26] high risk in 1 trial,[13] and unclear in 2 trials.[14,25] In all 5 trials, either there was no missing outcome data or the small proportion of unaccounted outcomes was balanced between the intervention and control groups. Therefore, there was a low risk of attrition bias in all included trials. Similarly, all 5 trials had a low risk of reporting bias.

Synthesis of results

The study outcomes are shown in Table 3. A total of 4 trials (n=1599 patients in the hands-and-knees group vs n=1579 patients in the control group) contributed to the primary outcome. In all 4 studies, the fetal head position was determined before any interventions (ie, manual or instrumented rotation) were performed. The rate of the composite primary outcome (ie, OA position in the second stage of labor or at birth) was the same for participants using the hands-and-knees posture vs control (81.2% vs 81.2%; RR, 1.03; 95% CI, 0.92−1.14; I^2=46%) (Figure 3). In addition, when the components of the primary outcome were assessed individually, there was also no difference in outcomes between the groups. The rate of OA position after the initial intervention period was higher in the hands-and-knees group compared with the control group, but this finding also did not reach statistical significance (34.1% vs 18.0%; RR, 1.60; 95% CI, 0.88−2.90; I^2 = 67%) (Figure 4).

Compared with controls, patients who adopted the hands-and-knees posture did not differ in terms of the rate of regional anesthesia use, duration of labor (total, first stage, or second stage), mode of delivery (vaginal delivery, operative delivery, or cesarean delivery), and third- or fourth-degree perineal laceration. Regarding the neonatal outcomes, there was no difference in birthweight or rate of Apgar score <7 at 5 minutes.

Data for the subgroup analyses are summarized in Table 4. In the prespecified subgroup analysis of patients in labor, hands-and-knees posturing did not affect the rate of OA positioning during the second stage of labor, at birth, or after the initial intervention. Similarly, there was no difference in the primary outcome for patients who were not in labor. However, 1 study[10] found that the use of hands-and-knees posturing in patients who were not in labor resulted in a higher rate of OA position immediately after the intervention period (75% vs 0%; RR, 31.37; 95% CI, 2.02−486.58). For the subgroup of patients with malpositioning diagnosed via ultrasound before study enrollment, hands-and-knees posturing resulted in an increased rate of OA positioning immediately after the intervention (17.0% vs 10.3%; RR, 1.63; 95% CI, 1.06−2.52; I^2 = 0%; 2 studies), however, this relationship did not persist at the time of delivery (50.8% vs 53.1%; RR, 1.00; 95% CI, 0.75−1.34; I^2 = 65%; 2 studies) (Figure 5). Only 1 study assessed the use of hands-and-knees posturing for the prevention of malpositioning. For this subgroup, there was no difference between the groups for the primary outcome. Lastly, there was no difference in the rate of OA positioning after the initial intervention for patients who maintained hands-and-knees posturing for more than 30 minutes compared with controls.

Comment

Main findings

This systematic review and meta-analysis suggest that the use of hands-and-knees posturing does not cause a significant increase in OA positioning after the initial intervention, during the second stage of labor, or at the time of birth. The same findings were noted for the subgroup of patients in labor. Only 1 study assessed the rate of OA positioning immediately after posturing in patients who were not in labor. The authors of this study found that the hands-and-knees posture increased the rate of OA positioning immediately after the study period; however, there was a notably wide CI and therefore this result should be interpreted with caution. For the subgroup of patients with malpositioning diagnosed via ultrasound, those who adopted hands-and-knees posturing were 1.6-fold more likely to have rotation to the OA position immediately after the intervention, but this relationship did not persist at the time of delivery. The remainder of the subgroup analyses and secondary outcomes were not significant. Although the groups did not differ with regard to the outcomes in general, there was an overall higher rate of OA positioning at delivery compared with that initially after intervention (Figure 5).

Strengths and limitations

This meta-analysis assessed the utility of hands-and-knees posturing on the rate of OA positioning. The strength of our study lies in its detailed literature review and exhaustive data analysis. Our study individually estimated the effect of this posture on the rate of OA positioning immediately after intervention, during the second stage of labor, and at birth. The subgroup analyses assessed utility of this posture specifically for patients in labor vs not in labor, those with malpositioning diagnosed via ultrasound, use of posturing for prevention vs treatment of malpositioning, and in patients who maintained posturing for more than 30 minutes.

Our study had several limitations. First was the heterogeneity of the included studies. One[25] was a large RCT that assessed posturing as a preventative measure and the other 4 studies[10,13,14,26] were small trials that assessed the use of hands-and-knees posturing to treat malpositioning after an OP or OT position was diagnosed. Second, there was also notable methodologic heterogeneity between the studies, such as differences in duration of the intervention and timing of posturing within the intervention groups. Although all forms of hands-and-knees posturing were combined in our analysis, the variations were small and therefore unlikely to affect our results. In addition, although the intervention duration in the included studies varied from 10 to 60 minutes, there were no differences in the outcomes of the subgroup analysis of patients who maintained posturing for more than 30 minutes. Another area of heterogeneity was the difference in the postures used

TABLE 3
Primary and secondary outcomes

	Andrews et al,[10]	Kariminia et al,[25]	Stremler et al,[26]	Molina Reyes et al[13]	Guittier et al[14]	Total	I^2	Mean difference or RR (95% CI)
Primary outcome								
Composite of OA position during the second stage of labor or at birth	NR	1122/1292 (86.8) vs 1091/1255 (87.9)	41/60 (68.3) vs 36/62 (58.1)[a]	53/65 (81.5) vs 56/70 (80.0)	82/182 (45.1) vs 99/192 (51.6)	1298/1599 (81.2) vs 1282/1579 (81.2)	46%	1.03 (0.92–1.14)
Secondary outcomes								
OA position after initial intervention	60/80 (75.0) vs 0/20 (0)	NR	11/68 (16.2) vs 5/73 (6.8)[b]	36/65 (55.4) vs 38/70 (54.3)	35/203 (17.2) vs 24/209 (11.5)	142/416 (34.1) vs 67/372 (18.0)	67%	1.60 (0.88–2.90)
OA position during the second stage of labor	NR	NR	NR	NR	82/182 (45.1) vs 99/192 (51.6)	82/182 (45.1) vs 99/192 (51.6)	NA	0.87 (0.71–1.08)
OA position at birth	NR	1122/1292 (86.8) vs 1091/1255 (87.9)	41/60 (68.3) vs 36/62 (58.1)[a]	53/65 (81.5) vs 56/70 (80.0)	NR	1216/1417 (85.8) vs 1183/1387 (85.3)	49%	1.06 (0.94–1.20)
Use of regional anesthesia	NR	372/1292 (28.8) vs 257/1255 (28.4)	26/70 (37.1) vs 25/77 (32.5)	24/65 (36.9) vs 46/70 (65.7)	211/220 (96.3) vs 211/219 (96.8)	633/1647 (38.4) vs 539/1621 (33.3)	91%	1.00 (0.76–1.33)
Total duration of labor (min)	NR	422±282.3 vs 419±267.9	306±253 vs 378±293[c]	NR	NR	NA	61%	−21.57 (−90.57 to −41.42)
First stage of labor	NR	NR	NR	383±235 vs 389±204	354±195 vs 369±158	NA	0%	−13.49 (−43.80 to −16.81)
Second stage of labor	NR	NR	NR	97±54 vs 98±69	48±31 vs 43±41	NA	0%	4.43 (−2.04 to 10.90)
Mode of delivery								
Vaginal	NR	949/1292 (73.5) vs 930/1255 (74.1)	53/70 (75.7) vs 53/77 (68.8)	42/65 (64.6) vs 53/70 (75.7)	118/220 (53.6) vs 134/219 (61.2)	1162/1647 (70.6) vs 1170/1621 (72.2)	37%	0.96 (0.88–1.05)
Operative[d]	NR	178/1292 (13.8) vs 161/1255 (12.8)	9/70 (12.9) vs 14/77 (18.2)	20/65 (30.8) vs 11/70 (15.7)	48/220 (21.8) vs 50/219 (22.8)	255/1647 (15.5) vs 236/1621 (14.6)	37%	1.07 (0.83–1.39)
Cesarean delivery	NR	165/1292 (12.8) vs 164/1255 (13.1)	8/70 (11.4) vs 10/77 (13.0)	3/65 (4.6) vs 6/70 (8.6)	54/220 (24.5) vs 35/219 (15.9)	230/1647 (14.0) vs 215/1621 (13.3)	44%	1.09 (0.78–1.51)
Third- or fourth-degree perineal laceration	NR	NR	2/70 (2.9) vs 0/77 (0)	0/65 (0) vs 1/70 (1.4)	1/220 (0.5) vs 5/219 (2.3)	3/355 (0.8) vs 6/366 (1.6)	37%	0.61 (0.08–4.46)
Neonatal birthweight (g)	NR	3544±472.1 vs 3537±445	3385±400 vs 3420±449[c]	3340±458 vs 3417±435	3422±401 vs 3411±406	NA	0%	2.08 (−28.65 to 32.82)
Apgar score <7 at 5 min	NR	NR[e]	0/70 (0) vs 2/77 (2.6)	0/65 (0) vs 0/70 (0)	4/220 (1.8) vs 4/219 (1.8)	4/355 (1.1) vs 6/366 (1.6)	0%	0.79 (0.24–2.61)

Data shown as intervention vs control with n/N (percentage) or mean ± standard deviation unless otherwise specified.

CI, confidence interval; *NA*, not applicable; *NR*, not recorded; *OA*, occiput anterior; *RR*, relative risk.

[a] Fetal head position was not assessed at delivery for 10 participants in the intervention group and 15 participants in the control group—these participants were omitted from the total during analysis; [b] Fetal head position was not assessed after initial intervention for 2 participants in the intervention group and 4 participants in the control group—these participants were omitted from the total during analysis; [c] Parametric data converted to mean ± standard deviation from median with interquartile range; [d] Operative delivery includes vacuum-assisted vaginal delivery or forceps-assisted vaginal delivery; [e] Median Apgar score at 5 minutes was 9 for both groups.

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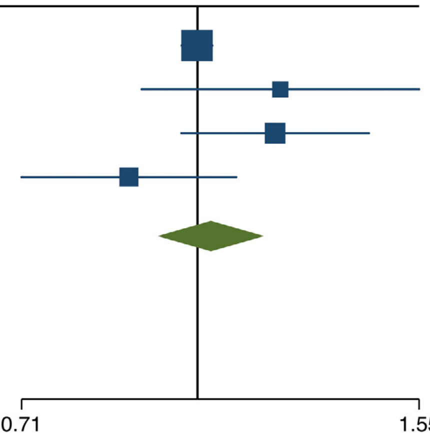
FIGURE 3
Forest plot of the primary outcome, occiput anterior position at delivery.

Study	Hands-and-knees Events	Hands-and-knees Total	Controls Events	Controls Total	Risk Ratio with 95% CI	Weight (%)
Kariminia (2004)	1,122	1292	1,091	1255	1.00 [0.97, 1.03]	51.46
Stremler (2005)	41	60	36	62	1.18 [0.90, 1.55]	11.54
Molina-Reyes (2014)	53	65	56	70	1.16 [0.97, 1.40]	20.14
Guittier (2016)	82	182	99	192	0.87 [0.71, 1.08]	16.86
Overall					1.03 [0.92, 1.14]	

Heterogeneity: $\tau^2 = 0.01$, $I^2 = 46.00\%$, $H^2 = 1.85$

Test of $\theta_i = \theta_j$: Q(3) = 5.56, p = 0.14

Test of $\theta = 0$: z = 0.49, p = 0.62



Random-effects DerSimonian-Laird model

CI, confidence interval.

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during the study period and the postures permitted afterward in the control group. Following pooled analysis, elective use of hands-and-knees posturing after the initial study period was different between the groups. Individual participant data were not available to adjust for this difference. Given that our outcome was fetal head position in the second stage of labor or at birth, it is possible that this confounded our findings. However, this difference between the groups was likely owing to chance given the fact that randomization within the individual RCTs should have eliminated selection bias. Regarding statistical heterogeneity between the studies, the meta-analysis for regional anesthesia use was the only outcome that had an I^2 above 75%. The effect of posturing on this outcome within the individual studies was consistent with our finding in that there was no difference between the groups. The high heterogeneity for this outcome was likely caused by differences in anesthesia availability and the popularity of use

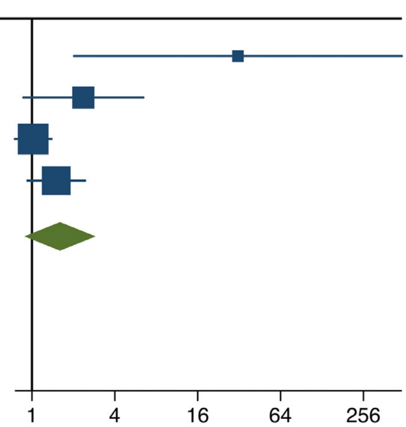
FIGURE 4
Forest plot of the rate of OA position after initial intervention

Study	Hands-and-knees Yes	Hands-and-knees Total	Controls Yes	Controls Total	Risk Ratio with 95% CI	Weight (%)
Andrews (1983)	60	80	0	20	31.37 [2.02, 486.58]	4.28
Stremler (2005)	11	68	5	73	2.36 [0.87, 6.45]	19.87
Molina-Reyes (2014)	36	65	38	70	1.02 [0.75, 1.39]	40.72
Guittier (2016)	35	203	24	209	1.50 [0.93, 2.43]	35.13
Overall					1.60 [0.88, 2.90]	

Heterogeneity: $\tau^2 = 0.20$, $I^2 = 66.93\%$, $H^2 = 3.02$

Test of $\theta_i = \theta_j$: Q(3) = 9.07, p = 0.03

Test of $\theta = 0$: z = 1.54, p = 0.12



Random-effects DerSimonian-Laird model

CI, confidence interval; *OA,* occiput anterior.

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TABLE 4
Outcomes of subgroup analyses

Subgroup population	Outcome	Included studies	Total	I²	RR (95% CI)
Patients in labor at time of intervention	OA position during second stage of labor or at birth	Stremler et al[26] (2005), Molina Reyes et al[13] (2014), and Guittier et al[14] (2016)	176/307 (57.3) vs 191/324 (59.0)	58%	1.06 (0.87–1.29)
	OA position after initial intervention	Stremler et al[26] (2005), Molina Reyes et al[13] (2014), and Guittier et al[14] (2016)	82/336 (24.4) vs 67/352 (19.0)	45%	1.31 (0.88–1.95)
Patients not in labor at time of intervention	OA position in second stage of labor or at birth	Kariminia et al[25] (2004)	1122/1292 (86.8) vs 1091/1255 (87.9)	NA	1.00 (0.97–1.03)
	OA position after initial intervention	Andrews et al[10] (1983)	60/80 (75.0) vs 0/20 (0)	NA	31.37 (2.02–486.58)[a]
Patients with ultrasound-diagnosed malposition before enrollment[b]	OA position in second stage of labor or at birth	Stremler et al[26] (2005) and Guittier et al[14] (2016)	123/242 (50.8) vs 135/254 (53.1)	65%	1.00 (0.75–1.34)
	OA position after initial intervention	Stremler et al[26] (2005) and Guittier et al[14] (2016)	46/271 (17.0) vs 29/282 (10.3)	0%	1.63 (1.06–2.52)[a]
Patients using posturing for treatment of malposition[b]	OA position in second stage of labor or at birth	Stremler et al[26] (2005), Molina Reyes et al[13] (2014), and Guittier et al[14] (2016)	176/307 (57.3) vs 191/324 (59.0)	58%	1.06 (0.87–1.29)
	OA position after initial intervention	Andrews et al[10] (1983), Stremler et al[26] (2005), Molina Reyes et al[13] (2014), and Guittier et al[14] (2016)	142/416 (34.1) vs 67/372 (18.0)	67%	1.60 (0.88–2.90)
Patients using posturing for prevention of malposition[b]	OA position in second stage of labor or at birth	Kariminia et al[25] (2004)	1122/1292 (86.8) vs 1091/1255 (87.9)	NA	1.00 (0.97–1.03)
	OA position after initial intervention	NR	NR	NA	NA
Patients using posturing for > 30 min[b]	OA position in second stage of labor or at birth	NR	NR	NA	NA
	OA position after initial intervention	Molina Reyes et al[13] (2014) and Guittier et al[14] (2016)	57/215 (26.5) vs 62/279 (22.2)	34%	1.18 (0.83–1.68)

Data shown as intervention vs control with n/N (%) unless otherwise specified.

CI, confidence interval; *NA*, not applicable; *NR*, not recorded; *OA*, occiput anterior; *RR*, relative risk.

[a] Statistically significant finding; [b] Post hoc subgroup analysis.

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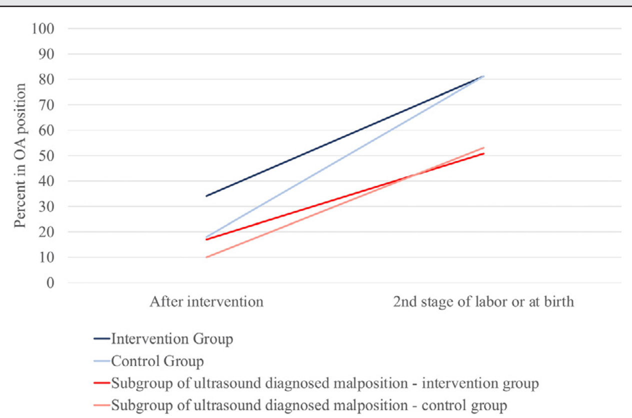
FIGURE 5
Percentage in OA position at two time points.



OA, occiput anterior.

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related to the study year and location. Therefore, although the possibility for a type II error exists, we do not feel that this heterogeneity is too significant to exclude this outcome from our study. In addition, the mode of determining fetal head position (ie, palpation or ultrasound) before intervention differed between studies. Previous literature has suggested that determination of the fetal position via routine digital examination during labor is incorrect in up to 65% of cases.[27,28] Therefore, ultrasound may be the preferred method to diagnose malpositioning.[28] Our study accounted for this difference via a subgroup analysis. Interestingly, in patients with ultrasound-diagnosed malpositioning, the use of hands-and-knees posturing resulted in an increased rate of OA positioning after the initial intervention, however, this relationship did not persist at time of delivery. This finding, however, is limited by the fact that only 2 studies were included in the analysis. Lastly, we adjusted our registration with PROSPERO to be able to include a large trial that began enrolling women at 36 weeks' gestation. However, since the gestational age at the time of intervention in this study did not vary from our original submission (≥37 weeks), and the decision to make this change occurred before performing any statistical analyses, we did not feel this change introduced a significant bias to our findings. Given the large sample size of this trial, the change in our PROSPERO registration was intended solely to improve the overall significance of our findings. The remaining limitations were inherent to the individual trials. For example, because of the nature of the intervention, blinding of participants was not possible. Importantly, however, the personnel determining the outcomes were blinded in the majority of studies; therefore, our findings are unlikely to be impacted by this bias.

Comparison with existing literature

Our findings expand upon what has been shown in previous literature. A 2007 Cochrane review concluded that there was incomplete evidence to support the use of hands-and-knees posturing to manage fetal OP positioning in nonlaboring patients; however, only a single trial for each outcome was included.[12] Our study incorporated 3 additional studies (N=721), all of which evaluated the efficacy of posturing in patients during labor.[13,14,26]

We found that in patients with malpositioning diagnosed via ultrasound, hands-and-knees posturing may be effective to promote immediate fetal rotation to the OA position. However, our study confirms that hands-and-knees posturing is not an effective treatment modality to increase the rate of OA positioning at the time of delivery. Our findings are also consistent with studies that assessed the use of a combination of postures. In a randomized trial by Desbriere et al[20], use of a series of successive postures, 1 of which included the hands-and-knees posture, did not result in a significant difference in the rate of persistent OP positioning in patients during labor. Given that only 1 study assessed the efficacy of hands-and-knees posturing as a preventative measure, future research is needed before definitive conclusions can be made.

Although not different between groups, our study found that there was a higher overall rate of OA positioning at delivery than in the period immediately after intervention. This suggests that time in and of itself influences the fetal position and that many fetuses will rotate spontaneously during labor. This is consistent with previous literature which has found that the OP position persisted in 21.5% of fetuses when diagnosed when the cervix was 3 to 5 cm dilated compared with 43.8% when diagnosed when 10 cm dilated.[3] Therefore, posturing may be most useful if performed when the patient is in active labor and malpositioning is persistent.

Our study did not assess pain reduction as an outcome, but in the included trials, there was conflicting evidence to support the use of hands-and-knees posturing to reduce pain. One study[26] reported a significant reduction in back pain following adoption of the hands-and-knees posture; however, a second study[14] found no difference in pain after the intervention. In addition, this meta-analysis did not assess patient comfort with posturing. In the study by Kariminia et al,[25] more than half of the patients who withdrew from the trial cited discomfort as the primary reason. In our study, the higher rate of elective use of hands-and-knees posturing after the study period within the control group compared with the intervention group further supports that this posture may not be preferred by patients. Further research is needed to assess the comfort of hands-and-knees posturing and its effect on pain reduction during labor.

Conclusion and implications

The maternal adoption of hands-and-knees posturing has been cited as a low-risk intervention to manage OP or OT positioning of the fetal head.[10] This systematic review and meta-analysis found that in patients with ultrasound-diagnosed malpositioning, use of the hands-and-knees posture may cause an increased rate of OA positioning immediately after the intervention; however, this finding is limited by the fact that only 2 studies were included in the analysis. In addition, in this same subgroup, the hands-and-knees posture does not affect the rate of OA position at delivery. It seems that time alone helps to facilitate rotation from OP or OT to an OA position and not the implementation of hands-and-knees posturing. Future research is needed to determine if alternative postures, either alone or in combination, are effective in promoting OA positioning, as well as to assess the utility of posturing for pain reduction in labor. ■

ACKNOWLEDGMENTS

The authors would like to thank Andy Hickner for his help with the development of the search strategy and Dr Gabriele Saccone for his assistance with statistical analysis.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ajogmf.2021.100346.

Appendix — Search strategy

(((hand*) OR (knee*) OR (position*)) AND ((occiput posterior OR occipito-posterior OR occiput-posterior) OR (occiput transverse))) ■

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