Cochrane Library

Cochrane Database of Systematic Reviews

Maternal postures for fetal malposition in labour for improving the health of mothers and their infants (Review)

Barrowclough JA, Lin L, Kool B, Hofmeyr GJ, Crowther CA

Barrowclough JA, Lin L, Kool B, Hofmeyr GJ, Crowther CA.
Maternal postures for fetal malposition in labour for improving the health of mothers and their infants.
Cochrane Database of Systematic Reviews 2022, Issue 8. Art. No.: CD014615.
DOI: 10.1002/14651858.CD014615.

www.cochranelibrary.com

WILEY

TABLE OF CONTENTS

ABSTRACT 1
PLAIN LANGUAGE SUMMARY 2
SUMMARY OF FINDINGS 4
BACKGROUND 11
OBJECTIVES 12
METHODS 12
Figure 1. 14
Figure 2. 16
RESULTS 19
Figure 3. 22
Figure 4. 23
DISCUSSION 30
AUTHORS' CONCLUSIONS 34
ACKNOWLEDGEMENTS 34
REFERENCES 35
CHARACTERISTICS OF STUDIES 40
DATA AND ANALYSES 53
Analysis 1.1. Comparison 1: Hands and knees posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth) 54
Analysis 1.2. Comparison 1: Hands and knees posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention 55
Analysis 1.3. Comparison 1: Hands and knees posture versus other postures, Outcome 3: Duration of labour 55
Analysis 1.4. Comparison 1: Hands and knees posture versus other postures, Outcome 4: Oxytocin augmentation 55
Analysis 1.5. Comparison 1: Hands and knees posture versus other postures, Outcome 5: Pain score (as defined by trialists using standardised tools available) 55
Analysis 1.6. Comparison 1: Hands and knees posture versus other postures, Outcome 6: Pain score (as defined by trialists using standardised tools available 56
Analysis 1.7. Comparison 1: Hands and knees posture versus other postures, Outcome 7: Improved comfort 56
Analysis 1.8. Comparison 1: Hands and knees posture versus other postures, Outcome 8: Epidural use 56
Analysis 1.9. Comparison 1: Hands and knees posture versus other postures, Outcome 9: Occipito-posterior/transverse position at birth 56
Analysis 1.10. Comparison 1: Hands and knees posture versus other postures, Outcome 10: Caesarean section 57
Analysis 1.11. Comparison 1: Hands and knees posture versus other postures, Outcome 11: Instrumental vaginal birth 57
Analysis 1.12. Comparison 1: Hands and knees posture versus other postures, Outcome 12: Episiotomy 57
Analysis 1.13. Comparison 1: Hands and knees posture versus other postures, Outcome 13: Severe perineal tears (3rd degree or higher, as defined by trialists) 58
Analysis 1.14. Comparison 1: Hands and knees posture versus other postures, Outcome 14: Maternal satisfaction (as defined by trialists using standardised tools available) 58
Analysis 1.15. Comparison 1: Hands and knees posture versus other postures, Outcome 15: Maternal satisfaction (as defined by trialists using standardised tools available) 58
Analysis 1.16. Comparison 1: Hands and knees posture versus other postures, Outcome 16: Apgar scores less than seven at five minutes 59
Analysis 2.1. Comparison 2: Any lateral posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth) 60
Analysis 2.2. Comparison 2: Any lateral posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention 60
Analysis 2.3. Comparison 2: Any lateral posture versus other postures, Outcome 3: Duration of labour 61
Analysis 2.4. Comparison 2: Any lateral posture versus other postures, Outcome 4: Oxytocin augmentation 61
Analysis 2.5. Comparison 2: Any lateral posture versus other postures, Outcome 5: Pain score (as defined by trialists using standardised tools) 61
Analysis 2.6. Comparison 2: Any lateral posture versus other postures, Outcome 6: Occipito-posterior/transverse position at birth 61
Analysis 2.7. Comparison 2: Any lateral posture versus other postures, Outcome 7: Caesarean section 62

Analysis 2.8. Comparison 2: Any lateral posture versus other postures, Outcome 8: Instrumental vaginal birth 62
Analysis 2.9. Comparison 2: Any lateral posture versus other postures, Outcome 9: Episiotomy 62
Analysis 2.10. Comparison 2: Any lateral posture versus other postures, Outcome 10: Severe perineal tears (3rd degree or higher, as defined by trialists) 63
Analysis 2.11. Comparison 2: Any lateral posture versus other postures, Outcome 11: Postpartum haemorrhage (as defined by trialists) 63
Analysis 2.12. Comparison 2: Any lateral posture versus other postures, Outcome 12: Maternal satisfaction (as defined by trialists using standardised tools available) 63
Analysis 2.13. Comparison 2: Any lateral posture versus other postures, Outcome 13: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists) 64
Analysis 2.14. Comparison 2: Any lateral posture versus other postures, Outcome 14: Apgar scores less than seven at five minutes 64
Analysis 2.15. Comparison 2: Any lateral posture versus other postures, Outcome 15: Admission to neonatal intensive care 64
Analysis 2.16. Comparison 2: Any lateral posture versus other postures, Outcome 16: Birth trauma (as defined by trialists) 65
Analysis 3.1. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth) 66
Analysis 3.2. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention 66
Analysis 3.3. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 3: Duration of labour 66
Analysis 3.4. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 4: Oxytocin augmentation 66
Analysis 3.5. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 5: Occipito-posterior/transverse position at birth 67
Analysis 3.6. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 6: Caesarean section 67
Analysis 3.7. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 7: Instrumental vaginal birth 67
Analysis 3.8. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 8: Episiotomy 68
Analysis 3.9. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 9: Severe perineal tears (3rd degree or higher, as defined by trialists) 68
Analysis 3.10. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 10: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists) 68
Analysis 3.11. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 11: Admission to neonatal intensive care 68
Analysis 3.12. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 12: Birth trauma (as defined by trialists) 69
Analysis 4.1. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth) 70
Analysis 4.2. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention 70
Analysis 4.3. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 3: Duration of labour 70
Analysis 4.4. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 4: Pain score (as defined by trialists using standardised tools) 71
Analysis 4.5. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 5: Occipito-posterior/transverse position at birth 71
Analysis 4.6. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 6: Caesarean section 71
Analysis 4.7. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 7: Instrumental vaginal birth 72
Analysis 4.8. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 8: Episiotomy 72
Analysis 4.9. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 9: Severe perineal tears (3rd degree or higher, as defined by trialists) 72
Analysis 4.10. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 10: Postpartum haemorrhage (as defined by trialists) 73
Analysis 4.11. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 11: Maternal satisfaction (as defined by trialists using standardised tools available) 73

Analysis 4.12. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 12: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists) 73
Analysis 4.13. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 13: Apgar scores less than seven at five minutes 74
Analysis 4.14. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 14: Admission to neonatal intensive care 74
APPENDICES 74
CONTRIBUTIONS OF AUTHORS 75
DECLARATIONS OF INTEREST 75
SOURCES OF SUPPORT 75
DIFFERENCES BETWEEN PROTOCOL AND REVIEW 75
NOTES 76

[Intervention Review]

Maternal postures for fetal malposition in labour for improving the health of mothers and their infants

Jennifer A Barrowclough[1,2], Luling Lin[1], Bridget Kool[3], G Justus Hofmeyr[4], Caroline A Crowther[1]

[1]Liggins Institute, University of Auckland, Auckland, New Zealand. [2]School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand. [3]Faculty of Medical and Health Sciences Administration, University of Auckland, Auckland, New Zealand. [4]Department of Obstetrics and Gynaecology, University of Botswana; University of Fort Hare, University of the Witwatersrand, Eastern Cape Department of Health, East London, South Africa

Contact: Caroline A Crowther, c.crowther@auckland.ac.nz.

Editorial group: Cochrane Pregnancy and Childbirth Group.
Publication status and date: New, published in Issue 8, 2022.

Citation: Barrowclough JA, Lin L, Kool B, Hofmeyr GJ, Crowther CA. Maternal postures for fetal malposition in labour for improving the health of mothers and their infants. *Cochrane Database of Systematic Reviews* 2022, Issue 8. Art. No.: CD014615. DOI: 10.1002/14651858.CD014615.

ABSTRACT

Background

Fetal malposition (occipito-posterior and persistent occipito-transverse) in labour is associated with adverse maternal and infant outcomes. Whether use of maternal postures can improve these outcomes is unclear. This Cochrane Review of maternal posture in labour is one of two new reviews replacing a 2007 review of maternal postures in pregnancy and labour.

Objectives

To assess the effect of specified maternal postures for women with fetal malposition in labour on maternal and infant morbidity compared to other postures.

Search methods

We searched Cochrane Pregnancy and Childbirth's Trials Register, ClinicalTrials.gov, the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP) (13 July 2021), and reference lists of retrieved studies.

Selection criteria

We included randomised controlled trials (RCTs) or cluster-RCTs conducted among labouring women with a fetal malposition confirmed by ultrasound or clinical examination, comparing a specified maternal posture with another posture. Quasi-RCTs and cross-over trials were not eligible for inclusion.

Data collection and analysis

Two review authors independently assessed trials for inclusion, risk of bias, and performed data extraction. We used mean difference (MD) for continuous variables, and risk ratios (RRs) for dichotomous variables, with 95% confidence intervals (CIs). We assessed the certainty of the evidence using the GRADE approach.

Main results

We included eight eligible studies with 1766 women.

All studies reported some form of random sequence generation but were at high risk of performance bias due to lack of blinding. There was a high risk of selection bias in one study, detection bias in two studies, attrition bias in two studies, and reporting bias in two studies.

Hands and knees

The use of hands and knees posture may have little to no effect on operative birth (average RR 1.14, 95% CI 0.87 to 1.50; 3 trials, 721 women; low-certainty evidence) and caesarean section (RR 1.34, 95% CI 0.96 to 1.87; 3 trials, 721 women; low-certainty evidence) but the evidence is uncertain; and very uncertain for epidural use (average RR 0.74, 95% CI 0.41 to 1.31; 2 trials, 282 women; very low-certainty evidence), instrumental vaginal birth (average RR 1.04, 95% CI 0.57 to 1.90; 3 trials, 721 women; very low-certainty evidence), severe perineal tears (average RR 0.88, 95% CI 0.03 to 22.30; 2 trials, 586 women; very low-certainty evidence), maternal satisfaction (average RR 1.02, 95% CI 0.68 to 1.54; 3 trials, 350 women; very low-certainty evidence), and Apgar scores less than seven at five minutes (RR 0.71, 95% CI 0.21 to 2.34; 2 trials, 586 babies; very low-certainty evidence).

No data were reported for the hands and knees comparisons for postpartum haemorrhage, serious neonatal morbidity, death (stillbirth or death of liveborn infant), admission to neonatal intensive care, neonatal encephalopathy, need for respiratory support, and neonatal jaundice requiring phototherapy.

Lateral postures

The use of lateral postures may have little to no effect on reducing operative birth (average RR 0.72, 95% CI 0.43 to 1.19; 4 trials, 871 women; low-certainty evidence), caesarean section (average RR 0.78, 95% CI 0.44 to 1.39; 4 trials, 871 women; low-certainty evidence), instrumental vaginal birth (average RR 0.73, 95% CI 0.39 to 1.36; 4 trials, 871 women; low-certainty evidence), and maternal satisfaction (RR 0.96, 95% CI 0.84 to 1.09; 2 trials, 451 women; low-certainty evidence), but the evidence is uncertain. The evidence is very uncertain about the effect of lateral postures on severe perineal tears (RR 0.66, 95% CI 0.17 to 2.48; 3 trials, 609 women; very low-certainty evidence), postpartum haemorrhage (RR 0.90, 95% CI 0.48 to 1.70; 1 trial, 322 women; very low-certainty evidence), serious neonatal morbidity (RR 1.41, 95% CI 0.64 to 3.12; 3 trials, 752 babies; very low-certainty evidence), Apgar scores less than seven at five minutes (RR 0.25, 95% CI 0.03 to 2.24; 1 trial, 322 babies; very low-certainty evidence), admissions to neonatal intensive care (RR 1.41, 95% CI 0.64 to 3.12; 2 trials, 542 babies; very low-certainty evidence) and neonatal death (stillbirth or death of liveborn) (1 trial, 210 women and their babies; no events).

For the lateral posture comparisons, no data were reported for epidural use, neonatal encephalopathy, need for respiratory support, and neonatal jaundice requiring phototherapy. We were not able to estimate the outcome death (stillbirth or death of liveborn infant) due to no events (1 trial, 210 participants).

Authors' conclusions

We found low- and very low-certainty evidence which indicated that the use of hands and knees posture or lateral postures in women in labour with a fetal malposition may have little or no effect on health outcomes of the mother or her infant. If a woman finds the use of hands and knees or lateral postures in labour comfortable there is no reason why they should not choose to use them. Further research is needed on the use of hands and knees and lateral postures for women with a malposition in labour. Trials should include further assessment of semi-prone postures, same-side-as-fetus lateral postures with or without hip hyperflexion, or both, and consider interventions of longer duration or that involve the early second stage of labour.

PLAIN LANGUAGE SUMMARY

Mothers' positions in labour when baby is lying 'back-to-back'

What is the issue?

Malposition is when the back of the baby's head lies towards the mother's back. As a result, labour and birth can be long and difficult, sometimes resulting in an operative birth (where the baby is delivered by caesarean section or with special tools to help the baby through the birth canal) and more perineal trauma (damage to the pelvic floor). The baby may be more likely to go to a neonatal care unit. Also, women may experience stress or disappointment with the birth experience.

Why is this important?

The way a pregnant woman is positioned during labour may help rotate a baby so that the back of the baby's head lies towards the front of the mother's abdomen. This improved position may help the mother and baby have a more normal labour and birth. However, it is not yet known which posture, if any, is effective and when is the best time to use it.

A systematic review of studies of positions (postures) used by women in labour with a baby in a malposition can provide answers on whether the postures improve birth and other health outcomes for mothers and babies. The summary of this review can be used to update clinical practice guidelines.

A Cochrane Review in 2007 reported that the use of the 'hands and knees' posture in labour was ineffective for malposition, but it did reduce labouring women's backache. Since then, more trials have been conducted, some using other postures; these need evaluating to see if those postures work.

What evidence did we find?

We searched for evidence (published to 13 July 2021) and identified eight studies in nine different countries involving 1766 women and their babies. Women in the included studies were either first-time mothers or mothers who had birthed before. All the women's pregnancies were at least at 36 weeks.

The trials compared use of 'hands and knees' posture or 'side-lying' (lateral) postures (lying on the same side as the baby, lying on the opposite side to the baby, and lying semi-prone) to other postures (free posture, lying on back, leaning back, lying on the same side as the baby).

For both the hands and knees posture and side-lying positions during labour, there may be little or no difference in the numbers of operative births, haemorrhage (profuse bleeding of the mother), severe perineal trauma, and women's satisfaction with their labour and delivery, but there was insufficient evidence to be sure. Many of our outcomes of interest were not reported in the included studies.

Overall, we have little to no confidence in the evidence, mainly because there were too few women and babies in the studies, and some studies used unclear methods.

What does this mean?

Overall, it is uncertain whether hands and knees or side-lying positions in labour improve the health of mother and baby when a baby is in a malposition. However, if women find the use of hands and knees, side-lying, or other postures in labour comfortable, there is no reason why they should not choose to use them.

Further research is needed to enable optimal fetal positioning. In particular, further research is needed on variations in the postures, the impact of longer use of these postures during labour, and on long-term outcomes for women and their babies.

SUMMARY OF FINDINGS

Summary of findings 1. Hands and knees posture compared to other postures for fetal malposition in labour - maternal outcomes

Hands and knees posture compared to other postures for fetal malposition in labour - maternal outcomes

Patient or population: fetal malposition in labour

Setting: secondary and tertiary labour and birthing units in France, Spain, Iran, Argentina, Australia, Canada, England, Israel, and the USA

Intervention: hands and knees posture

Comparison: other postures

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with other postures	Risk with hands and knees				
Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	**Study population**		**RR 1.14** (0.87 to 1.50)	721 (3 RCTs)	⊕⊕◯◯ Low[a,b]	Random effects
	344 per 1000	**392 per 1000** (300 to 516)				
Epidural use	**Study population**		**RR 0.74** (0.41 to 1.31)	282 (2 RCTs)	⊕◯◯◯ Very low[a,b,c]	Random effects
	476 per 1000	**352 per 1000** (195 to 624)				
Caesarean section	**Study population**		**RR 1.34** (0.96 to 1.87)	721 (3 RCTs)	⊕⊕◯◯ Low[a,b]	
	139 per 1000	**187 per 1000** (134 to 261)				
Instrumental vaginal birth	**Study population**		**RR 1.04** (0.57 to 1.90)	721 (3 RCTs)	⊕◯◯◯ Very low[a,b,c]	Random effects
	205 per 1000	**213 per 1000** (117 to 389)				
Severe perineal tears (3rd degree or higher, as defined by trialists)	**Study population**		**RR 0.88** (0.03 to 22.30)	586 (2 RCTs)	⊕◯◯◯ Very low[c,d,e]	Random effects
	17 per 1000	**15 per 1000** (1 to 377)				
Postpartum haemorrhage (as defined by trialists)	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				

Maternal satisfaction (as defined by trialists using standardised tools available)	**Study population**		**RR 1.02** (0.68 to 1.54)	350 (3 RCTs)	⊕◯◯◯ Very low[a,b,c]	Random effects
	424 per 1000	**432 per 1000** (288 to 652)				

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **MD**: mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]We downgraded one level for serious limitations in study design due to a high risk of performance bias in all studies. One of the included studies was at high risk of selection bias, detection bias, attrition bias, and reporting bias.
[b]We downgraded one level for serious imprecision: small sample size.
[c]We downgraded one level for serious inconsistency: substantial unexplained statistical heterogeneity.
[d]We downgraded one level for serious imprecision: for low event rate and small sample size with very wide confidence interval.
[e]We downgraded one level for serious risk of performance bias in both studies.

Summary of findings 2. Hands and knees posture compared to other postures for fetal malposition in labour - infant outcomes

Hands and knees posture compared to other postures for fetal malposition in labour - infant outcomes

Patient or population: fetal malposition in labour

Setting: secondary and tertiary labour and birthing units in France, Spain, Argentina, Australia, Canada, England, Israel, and the USA

Intervention: hands and knees posture

Comparison: other postures

Outcomes	**Anticipated absolute effects* (95% CI)**		**Relative effect (95% CI)**	**No. of participants**	**Certainty of the evidence (GRADE)**	**Comments**
	Risk with other postures	**Risk with hands and knees**				
Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	**0 per 1000** (0 to 0)				

care, neonatal encephalopathy, or as defined by trialists)						
Death (stillbirth or death of liveborn infant)	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcomes was not reported in the included trials.
	0 per 1000	0 per 1000 (0 to 0)				
Apgar scores < 7 at 5 minutes	**Study population**		**RR 0.71** (0.21 to 2.34)	586 (2 RCTs)	⨁◯◯◯ Very low[a,b]	
	20 per 1000	**14 per 1000** (4 to 47)				
Admission to neonatal intensive care	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				
Neonatal encephalopathy (as defined by trialists)	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				
Need for respiratory support	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				
Neonatal jaundice requiring phototherapy	**Study population**		Outcome not estimable	(0 RCTs)	-	This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **MD**: mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]We downgraded one level for serious limitations in study design due to high risk of performance bias in all studies. One of the included studies was at high risk of selection bias, detection bias, attrition bias, and reporting bias (not intention-to-treat analysis).
[b]We downgraded two levels for very serious imprecision: low event rate, small sample size, and very wide confidence interval.

Summary of findings 3. Lateral postures compared to other postures for fetal malposition in labour - maternal outcomes

Lateral postures compared to other postures for fetal malposition in labour - maternal outcomes

Patient or population: fetal malposition in labour
Setting: tertiary labour and birthing units in Spain, France, China, and Iran; and one primary unit (Spain)
Intervention: lateral postures
Comparison: other postures

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with other postures	Risk with lateral postures				
Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	Study population 378 per 1000	**272 per 1000** (162 to 449)	**RR 0.72** (0.43 to 1.19)	871 (4 RCTs)	⊕⊕◯◯ Low[a,b]	Random effects
Epidural use	Study population 0 per 1000	0 per 1000 (0 to 0)	Not estimable	(0 studies)	-	This outcome was not reported in the included trials.
Caesarean section	Study population 162 per 1000	**127 per 1000** (71 to 226)	**RR 0.78** (0.44 to 1.39)	871 (4 RCTs)	⊕⊕◯◯ Low[a,b]	Random effects
Instrumental vaginal birth	Study population 215 per 1000	**157 per 1000** (84 to 293)	**RR 0.73** (0.39 to 1.36)	871 (4 RCTs)	⊕⊕◯◯ Low[a,b]	Random effects
Severe perineal tears (3rd degree or higher, as defined by trialists)	Study population 16 per 1000	**11 per 1000** (3 to 40)	**RR 0.66** (0.17 to 2.48)	609 (3 RCTs)	⊕◯◯◯ Very low[d,e]	
Postpartum haemorrhage (as defined by trialists)	Study population 111 per 1000	**100 per 1000**	**RR 0.90** (0.48 to 1.70)	322 (1 RCT)	⊕◯◯◯ Very low[e,f]	

		(53 to 189)				
Maternal satisfaction (as defined by trialists using standardised tools available)	621 per 1,000	**596 per 1000** (522 to 677)	**RR 0.96** (0.84 to 1.09)	451 (2 RCTs)	⊕⊕◯◯ Low[c,g]	Measurement tools: Adapted Mackey Satisfaction Scale, and Likert Scale (4 options)

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **MD**: mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]We downgraded one level for serious limitations in study design due to a high risk of performance bias in all studies, detection bias in one study, reporting bias in one study and other bias (no intention-to-treat analysis) in one study.
[b]We downgraded one level for serious inconsistency: substantial unexplained statistical heterogeneity.
[c]We downgraded one level for serious imprecision: small sample size.
[d]We downgraded one level for serious limitations in study design due to a high risk of performance bias in all studies, detection bias in one study, and reporting bias in one study.
[e]We downgraded two levels for very serious imprecision: low event rate, small sample size, and very wide confidence interval.
[f]We downgraded one level for serious limitations in study design due to a high risk of performance bias in the only included study.
[g]We downgraded one level for serious limitations in study design due to a high risk of performance bias in both studies and detection bias in one study.

Summary of findings 4. Lateral postures compared to other postures for fetal malposition in labour - infant outcomes

Lateral postures compared to other postures for fetal malposition in labour - infant outcomes					
Patient or population: fetal malposition in labour **Setting:** tertiary labour and birthing units in France and China **Intervention:** lateral postures **Comparison:** other postures					
Outcomes	**Anticipated absolute effects* (95% CI)**	**Relative effect (95% CI)**	**No. of participants (studies)**	**Certainty of the evidence (GRADE)**	**Comments**

	Risk with other postures	Risk with lateral postures				
Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)	**Study population**		**RR 1.41** (0.64 to 3.12)	752 (3 RCTs)	⊕◯◯◯ Very low[a,b]	
	37 per 1000	**52 per 1000** (24 to 115)				
Death (stillbirth or death of liveborn infant)	**Study population**		Outcome not estimable	210 (1 RCT)	⊕◯◯◯ Very low[e,f]	Zero events for this outcome
	0 per 1000	0 per 1000				
Apgar scores less than seven at five minutes	**Study population**		**RR 0.25** (0.03 to 2.24)	322 (1 RCT)	⊕◯◯◯ Very low[b,c]	
	25 per 1000	**6 per 1000** (1 to 55)				
Admission to neonatal intensive care	**Study population**		**RR 1.41** (0.64 to 3.12)	542 (2 RCTs)	⊕◯◯◯ Very low[b,d]	
	37 per 1000	**52 per 1000** (24 to 115)				
Neonatal encephalopathy (as defined by trialists	**Study population**		Outcome not estimable			This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				
Need for respiratory support	**Study population**		Outcome not estimable			This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				
Neonatal jaundice requiring phototherapy	**Study population**		Outcome not estimable			This outcome was not reported in the included trials.
	0 per 1000	0 per 1000				

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **MD**: mean difference; **RR:** risk ratio

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]We downgraded one level for serious limitations in study design due to a high risk of performance bias in all studies, detection bias in one study, and reporting bias in one study (no intention-to-treat analysis).
[b]We downgraded two levels for very serious imprecision: low event rate, small sample size, and very wide confidence intervals.
[c]We downgraded one level for serious limitations in study design due to a high risk of performance bias and detection bias in the only included study.
[d]We downgraded one level for serious limitations in study design due to a high risk of performance bias in both studies, and detection bias in one study.
[e]We downgraded one level for serious limitations in study design due to a high risk of performance bias and reporting bias (no intention-to-treat analysis).
[f]We downgraded two levels for very serious imprecision: single small study with no events.

BACKGROUND

Description of the condition

In normal labour, the fetal head usually enters the maternal pelvis in the transverse diameter and then rotates anteriorly as the head descends into the mid pelvis. When the fetal head does not rotate anteriorly or instead rotates posteriorly the position is termed persistent and is a deviation from normal labour (Cunningham 2018). Commonly referred to as 'fetal malposition', it is described as occipito-posterior (OP) or 'back-to-back' when the back of the fetal head lies posteriorly in the back of the mother's pelvis and occipito-transverse (OT) when the back of the fetal head lies transversely (at the side of the mother's pelvis). The head will often be deflexed, likely due to forward application of the maternal sacral promontory on the fetal spine with consequential neck extension (Barth 2015). A deflexed fetal head presents a wider diameter to the maternal pelvis which can cause delayed entry and transition through the pelvis. The fetal head may extend further to a mento-anterior or mento-lateral/transverse position (where the chin is anterior or lateral/transverse) to the maternal pelvis. Unlike a well-flexed head which presents a uniformly round vertex (crown of the head) to the cervix, a deflexed head is not completely round which may lead to poor application and thus pressure to the cervix. Poor head to cervix contact in nulliparous women is associated with cervical dystocia (cervix failing to open) (Allman 1996; Kjaergaard 2008).

When the fetus is in an OP position, the fetal axis or the long line of the fetal body in relation to the long axis of the woman, is inclined towards the mother's symphysis pubis bone. In the case of an OT position, the fetus is inclined towards the opposite side of the mother's pelvis. In both these positions, the fetal axis does not align well with the mother's anteriorly tilted pelvic brim, unlike in an occipito-anterior (OA) positioned fetus where the fetal axis is towards the mother's sacrum facilitating entry into the anteriorly tilted pelvic brim.

Diagnosis

Fetal malposition may be diagnosed by a vaginal digital examination which finds the junction of the sagittal and lambdoidal sutures of the fetal head located in the transverse diameter of the maternal pelvis for OT position or at least 45 degrees posterior to the transverse diameter of the maternal pelvis for OP position (Cunningham 2018). Ultrasonographic detection of fetal malposition is more reliable than digital vaginal examination (Sherer 2002). Ultrasonography to diagnose fetal malposition can locate the position of the fetal orbits or cervical spine anteriorly or transversely to the maternal pelvis (Akmal 2003; Souka 2003; Zahalka 2005).

Prevalence

A fetal OP position occurs in 15% to 33% of labours with a cephalic (head-first) presentation. Most OP positioned fetuses spontaneously rotate to an anterior position by the end of labour. However, about 8% that are OP in early labour, and 10% to 20% that are OP in the early second stage of labour, will remain in this position until birth, with 70% of these undergoing an operative vaginal birth (forceps or vacuum extraction) or caesarean section (Gardberg 1998; Fitzpatrick 2001; Ponkey 2003; Akmal 2004; Phipps 2014). Women of African-American ethnicity have a higher prevalence of OP position during labour (Cheng 2006a). OP position is more prevalent in women with an under-developed pelvis associated with early age at first pregnancy (Blumenthal 1982), malnutrition, and infection (Martins 2011). OT position is associated with similar morbidities and occurs in 28% of labours, with 49% of these requiring an operative birth (Akmal 2004; Phipps 2014). Considering the similar morbidities associated with OP and OT fetal positions, these are commonly grouped together in research (Doggett 1967). Right OP/OT position is about twice as common as left OP/OT position (Randal 1952; Kutcipal 1959; Guittier 2016; Le Ray 2016). During labour, the fetus will usually rotate on the pelvic floor anteriorly (to the front). However, when the fetus is in an OP position, the labour may be less likely to progress to the second stage, as shown by 53% OP position versus 38% non-OP position at caesarean section births for a prolonged first stage of labour (Eggebo 2015).

Adverse health outcomes associated with fetal malposition

Fetal malposition is associated with a prolonged second stage labour (Senécal 2005), chorioamnionitis (Ponkey 2003), fetal distress (Ingemarsson 1980; Sokol 1981), severe perineal trauma (Parente 2009), anal sphincter injuries (Barbier 2007; Dudding 2008), and birth injury (Cheng 2006b), including brachial plexus injury (Cheng 2006c), hypoxic ischaemic encephalopathy (Liljestrom 2018), and subgaleal haematoma (Ashwal 2016). Operative vaginal and caesarean section deliveries with an OP position are associated with postpartum haemorrhage, endometritis (Cheng 2006a), extension of the uterine incision during caesarean section especially in second stage labour (de la Torre 2006), and increased risk of need for neonatal resuscitation and neonatal intensive care unit admission (Cheng 2006a). The level of care available at a facility may impact health outcomes associated with a fetal malposition related to the degree of maternity experience and resources available (Aiken 2015).

Fetal malposition has direct and indirect costs, including longer postnatal hospital stays for women and their infants. The economic burden of third- and fourth-degree perineal tears in England due to longer hospital stays was estimated to be GBP 14.5 million for the year 2013/14 (Orlovic 2017). A retrospective cohort study comparing women with severe perineal tears versus those without found the incidence of women having an OP positioned baby was 32% versus 4% respectively (Barbier 2007). In addition, there are ongoing costs of impaired sexual health (Lydon-Rochelle 2001), and emotional health, such as chronic post-traumatic stress disorder which has a prevalence of 1% to 2% following traumatic births (Wijma 1997; Ayers 2001).

Aetiology

The aetiology of OP fetal position is uncertain. The greater propensity for right OP/OT fetal position compared to left OP/OT position may relate to dextrorotation of the uterus (oblique tilt of the uterus towards the right) with some fetuses on the right of the mother more inclined to rotate posteriorly and fetuses on the mother's left to rotate anteriorly. Dextrorotation of up to 45 degrees is considered normal physiologically and occurs commonly in the gravid (pregnant) uterus, most likely due to the presence of the sigmoid colon (large bowel) on the maternal left (Anderson 1965; El-Mowafi 2017). Fetal malposition is associated with nulliparity (Fitzpatrick 2001), narrow pubic arch angle typical of the anthropoid and android pelvis (Suonio 1986; Gilboa 2013; Ghi 2016), epidural analgesia (Lieberman 2005; Menichini 2021), anterior positioned placenta (Gardberg 1994), advanced maternal

age, African-American ethnicity, fetal macrosomia (Cheng 2006a), and increased maternal body mass index (BMI) (Akmal 2004). An association between epidural anaesthesia and fetal malposition has been linked to lax maternal uterine muscles to impair anterior fetal rotation during the first stage of labour (Robinson 1996; Boog 2006) or lax pelvic floor muscles to impair anterior rotation in the second stage of labour (Lieberman 2005).

Knowing whether malposition exists in late pregnancy or develops in first or second stage labour is important so that effective interventions can be appropriately timed before clinical situations, such as deep transverse arrest (transversely positioned fetal head stuck in the transverse diameter of the pelvis), occur. There is conflicting opinion regarding whether persistent OP position develops mostly during labour (nearly 70%) (Gardberg 1998; Lieberman 2005), or from the onset of labour (Akmal 2004).

Description of the intervention

Several maternal postures in labour that have been previously studied include the hands and knees posture, lateral postures, which include lying on the same side as the fetus, lying on the opposite side as the fetus, semi-prone, and vertical postures (standing up or supported standing).

Women may have been shown how to adopt specific posture/s as an intervention or may have used specific posture/s as a control. Use of the posture may have been for a specified time period or a collective minimum time requirement per hour or until birth of the baby. An ultrasound scan may have confirmed the fetal position prior to the intervention and during labour.

How the intervention might work

There are two different pathways by which maternal posture might work to rotate the baby anteriorly. These include: changes in pelvic angles and diameters inducing fetal head flexion and anterior rotation (Desbriere 2013), and the forces of gravity and buoyancy (Andrews 2004). Labour involves the passage of the shape of the baby through the shape of the pelvis. By adjusting the mother's posture, the shape and angles of her pelvis may provide a better fit for the baby's head shape. With effective descent of the head in labour, pressure is applied to the cervix leading to full dilatation. The head when in contact with the firm pelvic floor can rotate anteriorly aided by the slightly concave incline of the levator ani muscles (Parente 2009).

Alternatively, rotation of the occiput to an OA position may occur with gravitational forces on fetal weight. For example, in the symmetrical Sims/semi-prone posture (mother lying in a lateral-forwards posture on same side to location of fetal spine) the fetal spine, being the heaviest, may lead the weight of the fetal trunk by a falling action towards the centre of gravity, which is in this case located towards the mother's anterior aspect of her abdomen. Once the fetal trunk rotates anteriorly, the occiput repositions anteriorly (the fetus untwists its neck) (Barth 2015). An example of a similar mechanism is restitution, when, following the birth of the head, the head rotates to align with the trunk (Cunningham 2018).

Why it is important to do this review

Use of maternal posture may facilitate fetal rotation of OP or OT position to the more favourable OA position (Sutton 2000), coined as 'optimal fetal positioning', and associated with better birth and health outcomes.

Changes in maternal posture when there is a fetal malposition in labour may be a safe method to achieve a normal vaginal birth. As yet there is limited evidence on the appropriate maternal posture(s) to use, the optimal time to adopt the posture(s), or their effectiveness.

Conducting a systematic review of the evidence from randomised controlled trials of maternal posture in labour where there is a fetal malposition is important to establish their effectiveness for correcting the malposition, the effects on relevant maternal and infant morbidities, and the rates of operative births. The evidence from randomised trials summarised in this review is important for the update of evidence-based clinical practice guidelines.

A previous Cochrane Review, titled "Hands and knees posture in late pregnancy or labour for fetal malposition (lateral or posterior)" (Hunter 2007), found use of the hands and knees position for 10 minutes twice daily was not effective for improving maternal and neonatal outcomes of labour. The position was associated with reduced backache in labour. This review indicated further research was required on posture and its effect on progress or outcomes of labour in terms of pain, duration of labour, method of delivery, baby's condition, and maternal satisfaction (Hunter 2007). The Cochrane Review by Hunter and colleagues included randomised trials in late pregnancy and in labour. Since then, additional randomised trials on maternal posture for the management of labour in women with a fetus in OP or OT position have been conducted which use other posture interventions, some of which have reported positive effects on maternal and neonatal outcomes. The publication of new trials indicated that an updated evidence synthesis was necessary, and we decided to split the previous Cochrane Review by Hunter and colleagues into two new reviews: the present review focuses on maternal postures for fetal malposition in labour for improving the health of mothers and their infants, and its sister review focuses on maternal postures for fetal malposition in late pregnancy for improving the health of mothers and their infants.

OBJECTIVES

To assess the effect of specified maternal postures for women with fetal malposition in labour on maternal and infant morbidity compared to other postures.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) (published or unpublished) only. Cluster-randomised trials and trials published only as abstracts were eligible for inclusion, but none were identified. Quasi-randomised trials and cross-over studies were not eligible for inclusion in this review. We assessed trial methodology and risk of bias from full texts; none of the trials were reported only as abstracts.

We included information from other study designs in the Background and Discussion but we did not use it to inform the results or conclusions of this review.

Types of participants

Women in labour with a malposition of the fetus (occipito-posterior (OP), occipito-transverse (OT) (lateral), mento anterior/transverse (lateral)) diagnosed by digital vaginal examination or ultrasound.

Types of interventions

Specified maternal postures for women in labour with a fetal malposition compared with other maternal postures. This may have included maternal side-lying on the same side as the fetal spine, maternal side-lying on the opposite side to the fetal spine, maternal side-lying with hyperflexed hip/s, hand and knees posture, standing, semi-recumbent/recumbent (lying flat on back), sitting, squatting, or other postures. The intervention was compared with other postures, specified or unspecified, that excluded the intervention postures.

Types of outcome measures

The primary and secondary maternal and neonatal outcome measures were based on consensus between the review authors.

Primary outcomes

Maternal outcome

- Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Neonatal outcome

- Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)

Secondary outcomes

Maternal

Short-term outcomes

- Fetal malposition (OT/OP) after the intervention
- Duration of labour (in hours)
- Oxytocin augmentation
- Pain score (as defined by trialists using standardised tools)
- Epidural use
- Occipito-posterior/transverse position at birth
- Occipito-transverse arrest
- Caesarean section
- Instrumental vaginal birth
- Episiotomy
- Severe perineal tears (≥ third degree or as defined by trialists)
- Postpartum haemorrhage (as defined by trialists)
- Maternal satisfaction (as defined by trialists using standardised tools available)
- Postnatal depression (as defined by trialists)
- Any breastfeeding on discharge

Long-term outcomes

- Operative pelvic floor repair post discharge
- Post-traumatic stress referrals

Neonatal

Short-term outcomes

- Death (stillbirth or death of liveborn infant)
- Apgar scores less than seven at five minutes
- Admission to neonatal intensive care
- Neonatal encephalopathy (as defined by trialists)
- Need for respiratory support
- Neonatal jaundice requiring phototherapy
- Increased cord lactates (as defined by trialists), or low pH (as defined by trialists)
- Birth trauma (as defined by trialists)

Long-term outcomes

- Disability including developmental delay (as defined by trialists)

Search methods for identification of studies

The following section of this review is based on a standard template used by Cochrane Pregnancy and Childbirth.

Electronic searches

We searched Cochrane Pregnancy and Childbirth's Trials Register by contacting their Information Specialist (13 July 2021).

The Register is a database containing over 27,000 reports of controlled trials in the field of pregnancy and childbirth. It represents over 30 years of searching. For full current search methods used to populate Cochrane Pregnancy and Childbirth's Trials Register – including the detailed search strategies for the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, Embase and the Cumulative Index to Nursing and Allied Health Literature (CINAHL); the list of handsearched journals and conference proceedings; and the list of journals reviewed via the current awareness service – please follow this link.

Briefly, Cochrane Pregnancy and Childbirth's Trials Register is maintained by their Information Specialist and contains trials identified from:

- monthly searches of CENTRAL;
- weekly searches of MEDLINE (Ovid);
- weekly searches of Embase (Ovid);
- monthly searches of CINAHL (EBSCO);
- handsearches of 30 journals and the proceedings of major conferences;
- weekly current awareness alerts for a further 44 journals plus monthly BioMed Central email alerts.

Two people screen these search results and review the full texts of all relevant trial reports identified. Based on the intervention described, they assign each trial report a number corresponding to a specific Pregnancy and Childbirth review topic (or topics) and add the trial reports to the Register.' The Information Specialist searched the Register for this review using a topic number rather than keywords. This resulted in a more specific search set that has been fully accounted for in the relevant review sections (Included studies, Excluded studies, and Studies awaiting classification).

In addition, we searched ClinicalTrials.gov and the World Health Organization (WHO) International Clinical Trials Registry Platform

(ICTRP) for unpublished, planned, and ongoing trial reports using the search methods detailed in Appendix 1.

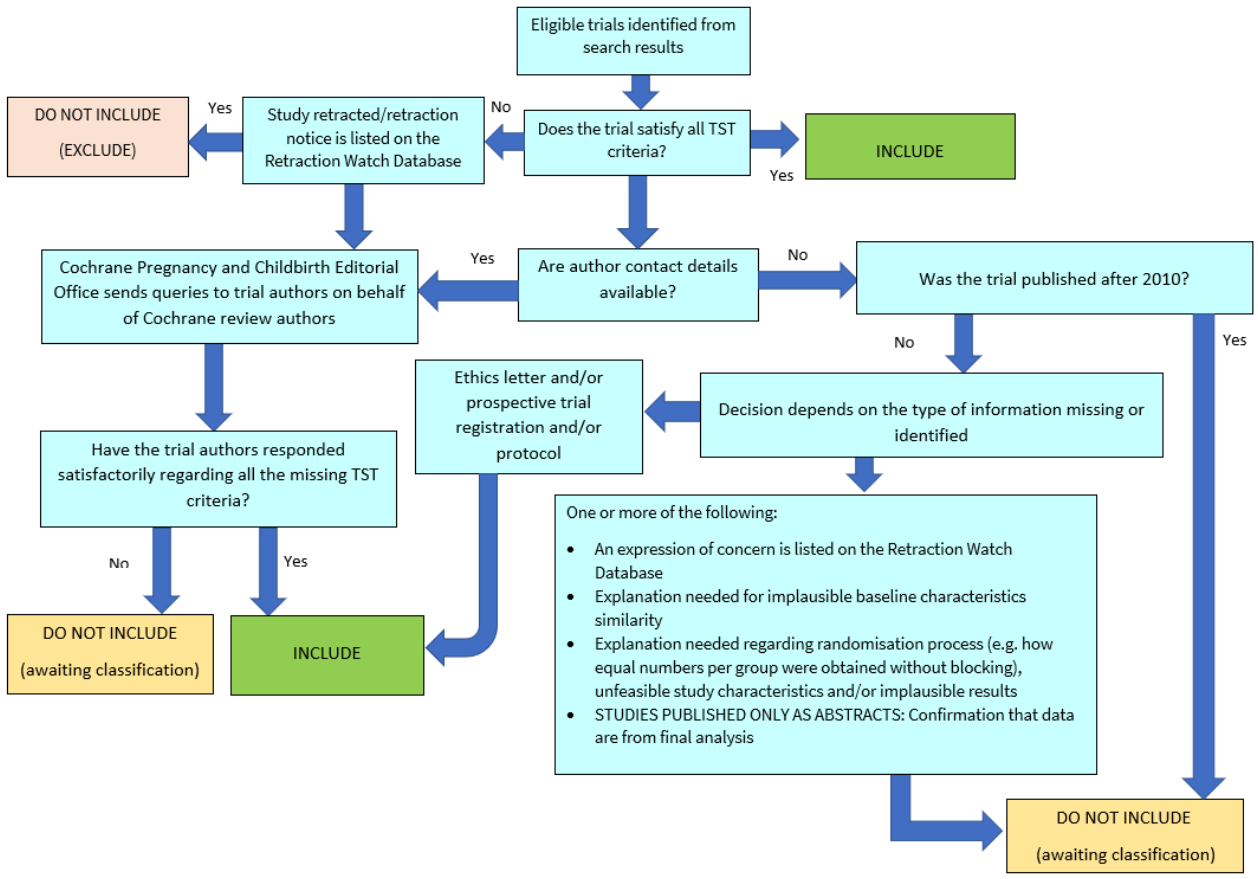
Searching other resources

We searched the reference lists of retrieved studies. We did not apply any language or date restrictions.

Data collection and analysis

The following section of this protocol is based on a standard template used by Cochrane Pregnancy and Childbirth Group (Figure 1).

Figure 1. Applying the Cochrane Pregnancy and Childbirth Trustworthiness Screening Tool



Screening eligible studies for trustworthiness

At least two review authors evaluated all studies meeting our inclusion criteria against predefined criteria to select studies that, based on available information, were deemed to be sufficiently trustworthy to be included in the analysis. Cochrane Pregnancy and Childbirth have developed a Trustworthiness Screening Tool (CPC-TST) which includes the following criteria.

Research governance

- Are there any retraction notices or expressions of concern listed on the Retraction Watch Database relating to this study?
- Was the study prospectively registered (for those studies published after 2010)? If not, was there a plausible reason?
- When requested, did the trial authors provide/share the protocol, the ethics approval letter, or both?
- Did the trial authors engage in communication with the Cochrane Review authors within the agreed timelines?
- Did the trial authors provide individual patient data (IPD) upon request? If not, was there a plausible reason?

Baseline characteristics

- Is the study free from participant characteristics that appear too similar (e.g. distribution of the mean (SD) excessively narrow or excessively wide, as noted by Carlisle 2017)?

Feasibility

- Is the study free from characteristics that could be implausible (e.g. large numbers of women with a rare condition (such as severe cholestasis in pregnancy) recruited within 12 months)?
- In cases with (close to) zero losses to follow-up, is there a plausible explanation?

Results

- Is the study free from results that could be implausible (e.g. massive risk reduction for main outcomes with small sample size)?
- Do the numbers randomised to each group suggest that adequate randomisation methods were used (e.g. is the study free from issues such as unexpectedly even numbers of women

'randomised' including a mismatch between the numbers and the methods, if the authors say 'no blocking was used' but still end up with equal numbers, or if the authors say they used 'blocks of 4' but the final numbers differ by 6)?

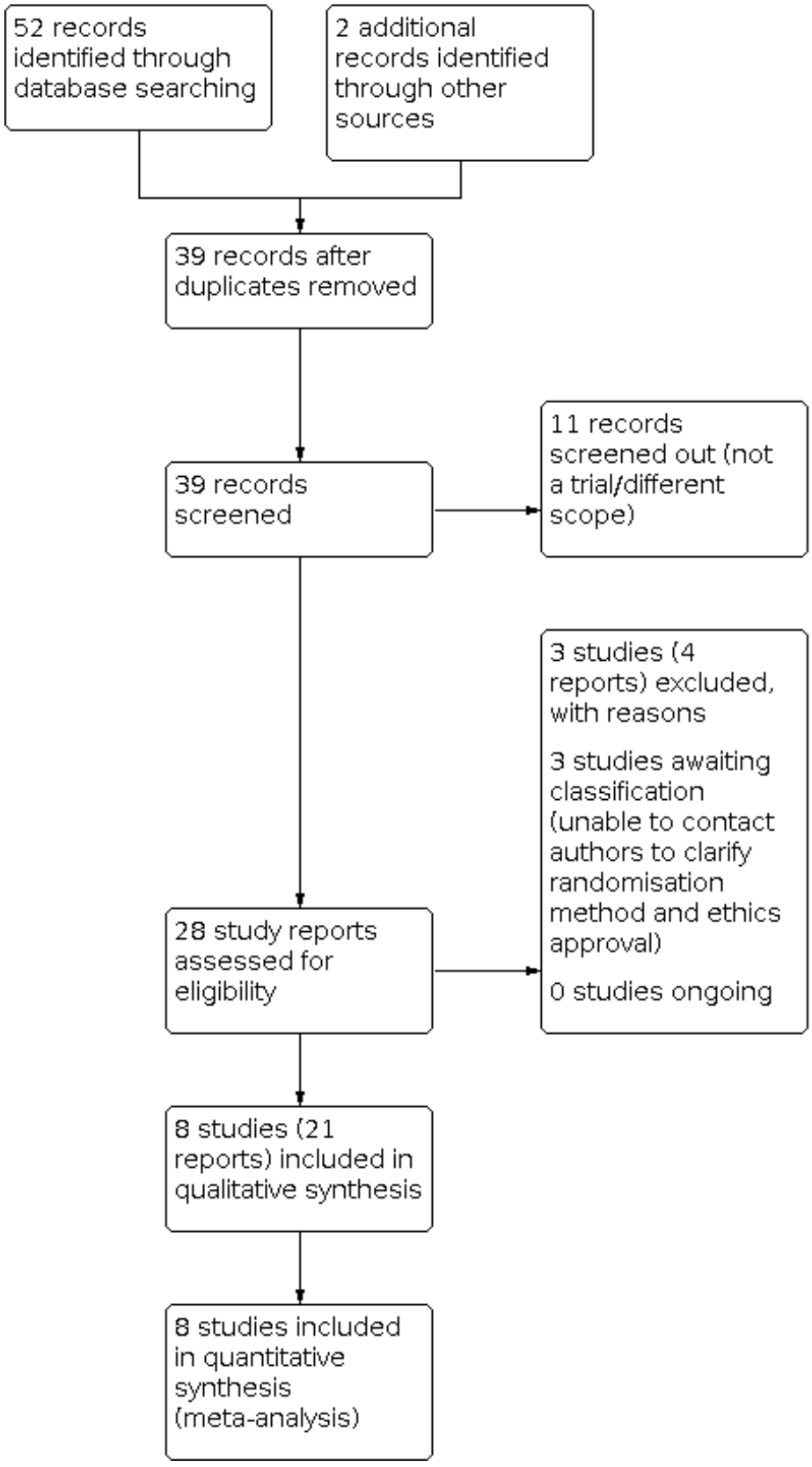
We did not include studies assessed as being potentially 'high risk' in the review. For studies classified as 'high risk,' we attempted to contact the study authors to address any possible lack of information or concerns. In cases where we could not obtain contact details for the study authors, or where adequate information remained unavailable, we listed the study as 'awaiting classification' and described in detail the reasons and our communications with the author (or lack thereof).

Abstracts

We included data from abstracts only if, in addition to the trustworthiness assessment, the study authors had confirmed in writing that the data to be included in the review had come from the final analysis and would not change. If such information was not available/provided, the study would remain in 'awaiting classification' (as above).

See Figure 2 for details of how we applied the trustworthiness screening criteria.

Figure 2. Study flow diagram



Selection of studies

Two review authors independently assessed for inclusion or exclusion all potential studies identified as a result of the search strategy. We resolved any disagreement on inclusion or exclusion through discussion; if required, we consulted a third review author.

We created a study flow diagram to map out the number of records identified, included, and excluded.

Data extraction and management

We designed a data extraction form based on the Cochrane Pregnancy and Childbirth Group's data extraction form. Two review authors collected information from the eligible studies relating to type of intervention, timing of intervention, concomitant treatments, and maternal and infant outcomes. We collected information about sources of funding and any declarations of interest by trialists. We resolved any disagreements through discussion. We entered all data from the data extraction forms into Review Manager 5.3 software (Review Manager 2014) and checked the data for accuracy. We attempted to contact authors of original reports if required to provide clarity or further information.

Assessment of risk of bias in included studies

Two review authors independently assessed risk of bias (ROB) for each study using methods described for ROB 1.0 in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We judged risk of biases as low, high, or unclear. We resolved any disagreement through discussion or by the involvement of a third assessor.

(1) Random sequence generation (checking for possible selection bias)

We described for each included study the method of allocation sequence in sufficient detail to determine the equipoise and thus comparability of groups. We assessed the method as:

- low risk of bias (unequivocal randomisation design, e.g. random number list; computer-generated random assignment);
- high risk of bias (use of alternation, e.g. date of birth, case record number, date of presentation, or other quasi randomisation); or
- unclear risk of bias (e.g. incomplete statement of the randomisation process).

(2) Allocation concealment (checking for possible selection bias)

We described for each included study the method used to conceal allocation to intervention assignment before and until assignment and assessed whether such allocation could have been foreseen during this time. We assessed the method as:

- low risk of bias (e.g. central or telephone randomisation by a third party; sequentially numbered, sealed, opaque envelopes);
- high risk of bias (unconcealed random allocation; e.g. unsealed or non-opaque envelopes); or
- unclear risk of bias (e.g. incomplete details of central randomisation process, unmarked envelopes prior to opening).

(3.1) Blinding of participants and personnel (checking for possible performance bias)

We described for each included study the reported method that was used (if any) for blinding of participants, personnel, or both. For each included study methodology that used unblinded participants, personnel, or both, we judged whether this lack of blinding would be likely to affect the results. We assessed methods as low, high, or unclear risk of bias for participants and personnel, respectively.

(3.2) Blinding of outcome assessment (checking for possible detection bias)

We described each included study's method of blinding outcome assessors to the intervention and assessed risk of bias for categories of outcomes (e.g. subjective or objective) separately as required. We assessed the method as low, high, or unclear risk of bias.

(4) Incomplete outcome data (checking for possible attrition bias due to the amount, nature, and handling of incomplete outcome data)

We described for each included study, and for each outcome or class of outcomes, the completeness of data, including attrition and exclusions from the analysis. We state whether attrition and exclusions were reported, and the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data were balanced across groups or were related to outcomes. Where sufficient information was reported, or was supplied by the trial authors, we re-included missing data in the planned analyses.

We assessed methods as:

- low risk of bias (e.g. no missing outcome data; missing outcome data balanced across groups);
- high risk of bias (e.g. numbers or reasons for missing data imbalanced across groups; 'as treated' analysis done with substantial departure of intervention received from that assigned at randomisation);
- unclear risk of bias.

(5) Selective reporting (checking for reporting bias)

We described for each included study how we investigated the possibility of selective outcome reporting bias and what we found. We assessed the methods as:

- low risk of bias (where it was clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review were reported);
- high risk of bias (where not all the study's pre-specified outcomes were reported; one or more reported primary outcomes were not pre-specified; outcomes of interest were reported incompletely and so could not be used; study failed to include results of a key outcome that would have been expected to have been reported);
- unclear risk of bias.

(6) Other bias (checking for bias due to problems not covered by (1) to (5) above)

We described for each included study any important concerns we had about other possible sources of bias. We assessed whether each study was free of other problems that could put it at risk of bias:

- low risk of other bias;
- high risk of other bias;
- unclear whether there is risk of other bias.

(7) Overall risk of bias

We made explicit judgements about whether studies were at high risk of bias, according to the criteria given in the *CochraneHandbook* (Higgins 2021). With reference to (1) to (6) above, we assessed the likely magnitude and direction of the bias and whether we considered it was likely to impact on the findings. We explored the impact of the level of bias through undertaking sensitivity analyses. See Sensitivity analysis.

Measures of treatment effect

Dichotomous data

For dichotomous data, we presented results as summary risk ratios (RRs) with 95% confidence intervals (CIs).

Continuous data

For continuous data, we used the mean differences (MDs) with 95% CIs if outcomes were measured in the same way between trials. Where different methods of measurement were used, we planned to use the standardised mean difference with 95% CIs to combine trials that measured the same outcome, but used different methods.

Unit of analysis issues

Cluster-randomised trials

We did not identify any cluster-RCTs. In future updates, if there are cluster-RCTs that meet our inclusion criteria, we will combine them with individually randomised trials in the analyses. We will adjust their sample sizes using the methods described in the *Cochrane Handbook* (Higgins 2022; Chapter 23), using an estimate of the intracluster correlation co-efficient (ICC) derived from the trial (if possible), from a similar trial, or from a study of a similar population. If we use ICCs from other sources, we will report this and conduct sensitivity analyses to investigate the effect of variation in the ICC. If we identify both cluster-randomised trials and individually-randomised trials, we plan to synthesise the relevant information. We will consider it reasonable to combine the results from both if there is little heterogeneity between the study designs and the interaction between the effect of intervention and the choice of randomisation unit is considered to be unlikely. We will also acknowledge heterogeneity in the randomisation unit and perform a sensitivity analysis to investigate the effects of the randomisation unit.

Other unit of analysis issues

Multiple pregnancy

Unit of analysis issues may arise when randomised women have a multiple pregnancy. We presented maternal data as per randomised woman and neonatal data as per infant.

Trials with multiple arms

Where trials had multiple arms, we used methods described in the *Cochrane Handbook* to avoid unit of analysis issues (Higgins 2022; Chapter 23), such as double counting of participants, by combining groups to create a single pair-wise comparison if appropriate, or by splitting the 'shared group' into two or more groups with smaller sample sizes and included two or more comparisons.

Dealing with missing data

For included studies, we noted levels of attrition. We explored the impact of including studies with high levels of missing data in the overall assessment of treatment effect by using sensitivity analysis.

For all outcomes, we carried out analyses, as far as possible, on an intention-to-treat basis; that is, we attempted to include all participants randomised to each group in the analyses, and all participants were analysed in the group to which they were allocated, regardless of whether or not they received the allocated intervention. The denominator for each outcome in each trial was the number randomised minus any participants whose outcomes were known to be missing.

Assessment of heterogeneity

We assessed statistical heterogeneity in each meta-analysis using the Tau^2, I^2 and Chi^2 statistics. We regarded heterogeneity as substantial if I^2 was greater than 30% and either Tau^2 was greater than zero, or there was a low P value (less than 0.10) in the Chi^2 test for heterogeneity.

Assessment of reporting biases

If there had been 10 or more studies in the meta-analysis,we planned to investigate reporting biases (such as publication bias) using funnel plots. We planned to assess funnel plot asymmetry visually. If asymmetry was apparent, we planned to perform exploratory analyses to investigate it.

Data synthesis

We carried out statistical analysis using the Review Manager 5 software (Review Manager 2014). We used fixed-effect meta-analysis for pooling data where it was reasonable to assume that studies were estimating the same underlying treatment effect: that is, where trials were examining the same intervention, and the trials' populations and methods were judged sufficiently similar. If there was clinical heterogeneity sufficient to expect that the underlying treatment effects differed between trials, or if substantial statistical heterogeneity was detected, we used random-effects meta-analysis to produce an overall summary if an average treatment effect across trials was considered clinically meaningful. The random-effects summary was treated as the average of the range of possible treatment effects and we discussed the clinical implications of treatment effects differing between trials. If the average treatment effect was not clinically meaningful, we did not combine trials.

Where we used random-effects analyses, we presented the results as the average treatment effects with 95% CIs, and the estimates of Tau^2 and I^2.

Subgroup analysis and investigation of heterogeneity

Where we identified substantial heterogeneity, we planned to investigate it using subgroup analyses and sensitivity analyses. We planned to consider whether an overall summary was meaningful, and if it was, to use random-effects analysis to produce it.

We planned to carry out the following subgroup analyses:

- parity (para 0 versus para ≥ 1);
- body mass index (BMI) (< 25 versus ≥ 25);
- birthweight (< 90th centile versus ≥ 90th centile);
- fetal position (left occipito-posterior/transverse versus right occipito-posterior/transverse);
- level of care facility (primary facility versus secondary or tertiary facility);
- ultrasound confirmation of malposition (ultrasound versus no ultrasound to confirm malposition).

We planned to restrict subgroup analysis to the review's primary outcomes.

We assessed subgroup differences by interaction tests available within Review Manager (Review Manager 2014). Results of subgroup analyses were to be reported quoting the Chi^2 statistic and P value, and the I^2 value.

Sensitivity analysis

Where there was significant heterogeneity or risk of bias associated with the quality of some of the included trials, we explored this with a sensitivity analysis for the primary outcomes. We compared trials with a low risk of bias for randomisation (including sequence generation, concealment of allocation, blinding) as well as an overall low risk of bias to trials judged as having a high or unclear risk of bias to measure if there was any difference to the result for primary outcomes.

Summary of findings and assessment of the certainty of the evidence

We assessed the certainty of the evidence using the GRADE approach, as outlined in the GRADE handbook (Schünemann 2013), for the following outcomes.

Maternal outcomes

- Operative birth (caesarean section, instrumental vaginal birth)
- Epidural use
- Caesarean section
- Instrumental vaginal birth
- Severe perineal tears (≥ third degree or as defined by trialists)
- Postpartum haemorrhage (as defined by trialists)
- Maternal satisfaction (as defined by trialists using standardised tools available)

Neonatal outcomes

- Serious neonatal morbidity (death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)
- Death (stillbirth or death of liveborn infant)
- Apgar scores less than seven at five minutes
- Admission to neonatal intensive care
- Neonatal encephalopathy (or as defined by trialists)
- Need for respiratory support
- Neonatal jaundice requiring phototherapy

We used the GRADEpro Guideline Development tool (GRADEpro GDT) to import data from Review Manager 5.3 (Review Manager 2014) in order to create summary of findings tables. We produced a summary of the intervention effect and a measure of certainty for each of the above outcomes using the GRADE approach. The GRADE approach uses five considerations (study limitations, consistency of effect, imprecision, indirectness, and publication bias) to assess the certainty of the body of evidence for each outcome. The evidence can be downgraded from 'high certainty' by one level for serious (or by two levels for very serious) limitations, depending on assessments for risk of bias, indirectness of evidence, serious inconsistency, imprecision of effect estimates, or potential publication bias.

RESULTS

Description of studies

This section describes the studies considered for inclusion in this review.

Results of the search

We assessed 26 study reports from the Cochrane Pregnancy and Childbirth search (July 2021), and two identified through other sources (Kariminia 2004; Molina-Reyes 2014).

We included eight studies (21 reports) and excluded three (four reports). Three studies, Lu 2001, Ou 1997 and Wu 2001, require further details to assess eligibility and therefore remain awaiting classification.

See Figure 2.

Screening eligible studies for trustworthiness

From the 11 studies identified as potentially eligible for inclusion, three studies, Lu 2001, Ou 1997 and Wu 2001, did not meet the criteria for trustworthiness for the following reasons. In all three, there was uncertainty about the randomisation process used, including no explanation of how women were allocated to each study group and who decided this, and no details of human ethics approval. We made every effort to contact authors. However, we could not locate contact details for authors of two studies, and authors of the remaining study did not respond. See Studies awaiting classification.

Included studies

Design

All eight included trials were parallel randomised controlled trials. Five trials were registered (Bahmaei 2018; Bueno-Lopez 2018; Guittier 2016; Le Ray 2016; Molina-Reyes 2014). Two trials commenced before 2010 when prospective registration was not required (Desbriere 2013; Stremler 2005); however, protocols pre-dating these trials were available. One trial only had ethics approval (Liu 2018). Three trials were prospectively registered (Guittier 2016; Le Ray 2016; Molina-Reyes 2014). The Bahmaei 2018 and Bueno-Lopez 2018 trials were retrospectively registered, though Bueno-Lopez 2018 also prospectively published the protocol as part of a doctoral thesis.

Study Dates

Seven trials were conducted/published between 2013 and 2018 (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Guittier 2016, Le Ray 2016; Liu 2018; Molina-Reyes 2014). Stremler 2005 was conducted/published in 2005.

Nearly three-quarters of participants (n = 1287/1766) were recruited for trials published in the last seven years.

Sample sizes

Le Ray 2016 and Guittier 2016 were the largest trials, randomising 322 and 439 women, respectively. Sample sizes for Desbriere 2013 and Liu 2018 were 200 and 226, respectively. The remaining four trials had sample sizes ranging from 120 to 180 (Bahmaei 2018; Bueno-Lopez 2018; Molina-Reyes 2014; Stremler 2005).

Setting

Five of the eight included trials were conducted in Europe. Of these, three were in France (Desbriere 2013; Guittier 2016; Le Ray 2016), and two were in Spain (Bueno-Lopez 2018; Molina-Reyes 2014). One trial was conducted in China (Liu 2018), one in Iran (Bahmaei 2018), and one multicentre trial was held in 13 university-affiliated hospitals worldwide (Stremler 2005). All of the trials included tertiary level hospitals and one trial, Le Ray 2016, also included Level 1 (primary care - in a community setting) and Level 2 (secondary care - hospital-based care with specialist level care available) hospitals.

Participants

All eight included trials had participants with a singleton pregnancy in early or active phase of labour with an OP fetal position confirmed via ultrasonography. One study confirmed fetal position with a second vaginal examination by another midwife or obstetrician if ultrasonography was not possible (Molina-Reyes 2014). Seven of the eight included trials recruited participants from 37 weeks' gestational age and one trial recruited women from 36 weeks' gestational age (Desbriere 2013). In one trial, all participants had an epidural at time of randomisation (Bueno-Lopez 2018), and in another trial, 93% of participants had epidural analgesia at the time of randomisation (Guittier 2016). In four of the trials, more than 90% of participants had epidural analgesia at the time of randomisation (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016). One trial had low numbers of women with an epidural analgesia at the time of randomisation (Stremler 2005), and one trial had fewer women with epidurals in the hands and knees posture group compared to the decubitus lateral group (Molina-Reyes 2014). Two trials did not report the use of epidural use or had no use of analgesia (Liu 2018 and Bahmaei 2018, respectively).

Interventions and comparisons

Hands and knees posture versus comparator posture

Four of the included trials utilised the hands and knees posture (Bahmaei 2018; Guittier 2016; Molina-Reyes 2014; Stremler 2005). In one of these trials, the posture used was described as prostration, in which the chest was on the bed, the hips were higher than the chest, and the hips rocked side to side for 15 to 30 minutes every hour (Bahmaei 2018). Two of the trials using the hands and knees posture similarly described the torso as either tilted forwards with back stretched (Guittier 2016), or the hands on the mattress, forearms on headboard, or thorax resting on a ball (Molina-Reyes 2014), for a minimum of 10 minutes or 30 minutes, respectively, after which women could remain in the posture or change postures. In the Stremler 2005 trial, the hands and knees posture was used for a minimum of 30 minutes and up to 60 minutes, and women were encouraged to continue the posture for the remainder of their labour.

Among the four trials using hands and knees as the intervention posture, two trials used free posture as the comparator (Guittier 2016; Stremler 2005). Specifically, women continued to use their pre-randomisation posture (excluding hands and knees) for at least one hour after randomisation after which they could adopt the hands and knees posture if they chose to (Guittier 2016), or use any posture except hands and knees, or any position that suspended the abdomen, and were encouraged to observe this exemption after the study period (Stremler 2005). Of the remaining two trials, Bahmaei 2018 used supine or lateral posture as the comparator which was maintained throughout labour, and Molina-Reyes 2014 used same-side-as fetus, decubitus-lateral posture as the comparator for a minimum of 30 minutes, or if no rotation occurred for those with a direct fetal occiput after 30 minutes, then the woman would adopt the contralateral posture (opposite side to fetus). After the intervention period, the women could use any posture they wished.

Lateral postures

Five of the included trials utilised lateral posture interventions (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018). Of these, two trials utilised a lateral posture in which the woman lay on the same side as their fetus (Bueno-Lopez 2018; Desbriere 2013), two trials utilised contralateral postures (opposite side to the fetus) (Le Ray 2016; Liu 2018), and one trial utilised a semi-prone lateral posture non-specific to fetal position in which the superior leg was hyperflexed, inferior leg slightly flexed, inferior arm placed towards the back and the superior arm was flexed (Bahmaei 2018).

Lateral postures on the same side as the fetus

One trial utilising the lateral decubitus posture on the same side as the fetus described the posture as a modified Sims posture in which the superior leg was flexed and the inferior leg straight (Bueno-Lopez 2018). The woman adopted this posture for 40 minutes every hour until either rotation or birth occurred. Women in the comparator group adopted free positions, but could only use lateral postures for up to 20 minutes each hour, and continued until either rotation or birth occurred. Another trial utilised a sequence of three postures, two of which were lateral decubitus postures on the same side as the fetus, depending on the station of the fetal head (Desbriere 2013). Specifically, a woman with a fetal head station between -5 cm and -3 cm adopted the hands and knees posture (Posture 1) (13%); and as the fetal station came to between -2 cm to 0 cm, they adopted 'Posture 2', a strict lateral recumbent position on the same side of the fetal spine with the inferior leg flexed and the superior leg positioned in the axis of the body; then at fetal head station greater than 0 cm, they adopted 'Posture 3', similar to 'Posture 2' but with the inferior leg in the axis of the body and the superior leg flexed at 90 degrees with the use of a leg support. If anterior rotation occurred, a woman was asked to adopt the dorsal recumbent position. Women in the comparator group adopted the dorsal recumbent (supine) posture.

Contralateral postures (opposite side to the fetus)

Two trials utilising contralateral intervention postures included hip flexion (superior leg) of 90 degrees or more (Le Ray 2016; Liu 2018). One trial placed the foot of the woman's superior leg on a foot pedal so the knee was as close to the abdomen as possible (Liu 2018). This intervention was compared with a contralateral posture without extreme hip flexion and abduction in which the

superior leg was flexed less than 90 degrees and the inferior leg was straight. The other trial had the woman's inferior leg straight and the posture was maintained for 30 to 60 minutes (Le Ray 2016). After one hour the woman was asked to continue the posture for as long as possible during the first stage of labour, after which the midwife or obstetrician could recommend maternal postures or attempt manual rotation according to the unit's practice. This intervention was compared to the use of the dorsal recumbent (supine) posture for one hour after randomisation then for as long as possible during labour. Later in labour, the woman could use any comparator position, except the lateral decubitus position, if they wanted or needed to due to fetal heart rate abnormalities. After the first stage, midwives and obstetricians could recommend other maternal postures or attempt manual rotation according to the unit's practice.

Outcomes

The primary maternal outcome of operative birth (composite outcome defined as caesarean section, instrumental vaginal birth) was reported in seven of the eight included trials (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005). Caesarean section and instrumental vaginal birth were reported in seven trials (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005). Fetal malposition (OP/OT after the intervention) was reported in seven trials (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005). Duration of labour was reported in hours or minutes (then converted to hours) as mean (± standard deviation) in five trials (Desbriere 2013; Guittier 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005). We converted median and interquartile range to mean and standard deviation for two trials (Desbriere 2013; Stremler 2005), to standardise measurements for analysis. Oxytocin augmentation was reported in two trials (Desbriere 2013; Stremler 2005). Pain score (as defined by trialists using standardised tools available) was reported by two trials (Le Ray 2016; Molina-Reyes 2014). Of these, Le Ray 2016 reported pain score as mean visual analogue score one hour after randomisation; standard error of the mean was reported so we converted this to standard deviation. The Molina-Reyes 2014 trial reported the difference between mean pain score before the intervention and in labour as categorical variables of either 'less', 'equivalent' or 'more'. For the meta-analysis, we used the 'more' pain score. Three other trials reported on pain score (Bahmaei 2018; Guittier 2016; Stremler 2005); however, we could not include these in the meta-analyses as there was either no report of standard deviation, total participants, or median and range. Comfort with the intervention was reported by two trials using Likert scales (Guittier 2016; Le Ray 2016). We used the categories 'comfort improved' and 'comfortable/very comfortable' from Guittier 2016 and Le Ray 2016, respectively, for this review. Epidural use was reported in three trials (Desbriere 2013; Molina-Reyes 2014; Stremler 2005). Occipito-posterior/transverse position at birth was reported in five trials (Desbriere 2013; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005). Episiotomy was reported in three trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016). Severe perineal tears (third degree or higher, as defined by trialists) was reported in four trials (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016). Postpartum haemorrhage (as defined by trialists) was reported in one trial (Le Ray 2016). Maternal satisfaction (as defined by trialists using standardised tools) was reported in three trials (Bahmaei 2018; Molina-Reyes 2014; Stremler 2005). Of these, Bahmaei 2018 and Molina-Reyes 2014 defined satisfaction as satisfaction with the delivery/birth experience, and Stremler 2005 defined satisfaction by whether women used the posture after the one-hour study period, as well as a mean score to evaluate the intervention position using the Labour Agentry Scale (Hodnett 1987). The Bueno-Lopez 2018 trial only reported two of the questions about satisfaction and only used P values, so we could not include its data. None of the trials reported on OT arrest, postnatal depression (as defined by trialists), any breastfeeding on discharge, operative pelvic floor repair post discharge, or post-traumatic stress referrals.

The primary neonatal outcome of serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists) was reported in three trials (Desbriere 2013; Le Ray 2016; Liu 2018). Death (stillbirth or death of a liveborn infant) was reported (as nil in both groups) in one trial (Liu 2018). Apgar score less than seven at five minutes was reported in three trials (Guittier 2016; Le Ray 2016; Stremler 2005). Admission to neonatal intensive care unit was reported in two trials (Desbriere 2013; Le Ray 2016). Birth trauma was reported in only one trial (Desbriere 2013). No trials reported on neonatal encephalopathy (as defined by trialists), need for respiratory support, neonatal jaundice requiring phototherapy, increased lactates or low PH (as defined by trialists), or disability including developmental delay (as defined by trialists).

Sources of trial funding

Seven of the eight included trials reported their funding sources as follows: Vice-chancellor of Research, Jundishapur University of Medical Sciences, Iran (Bahmaei 2018); University Hospital Val d'Hebron Research Institute, Barcelona (Bueno-Lopez 2018); Swiss National Science Foundation (SNFS) and other public/academic grants (Guittier 2016) (see the Characteristics tables); research grant from the French Ministry of Health CRC12002 and sponsored by the Department of Clinical Research and Development of the Public Assistance Hospital of Paris (Le Ray 2016); Funding Program for the Social Development (SH2014038), Health and Family Planning Commission, Government of Zhenjiang, China (Liu 2018); Ministry of Innovation and Science Company of Spain, Call for the Evaluation of Sanitary Technologies and Health Services (PI09/90739) and by the Ría de Salud de Andalucia PI-0336) (Molina-Reyes 2014); and grants from the Canadian Institutes of Health Research (CIHR), Ottawa, Ontario (grant MCT 50421), the American Nurses Foundation/Sigma Theta Tau International, Washington DC, and Indianapolis, Indiana (Nurse Scholar Award 99-123), the Faculty of Nursing, University of Toronto, and the Registered Nurses Foundation of Ontario, Toronto (Stremler 2005).

The remaining trial, Desbriere 2013, did not report their funding sources.

Trial authors' declarations of interest

Five of the eight included trials reported they had no conflicts of interest (Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014). The remaining three trials did not mention whether they had any conflicts of interest (Bahmaei 2018; Bueno-Lopez 2018; Stremler 2005).

Excluded studies

Of the three excluded studies, two were ineligible due to trial participants not being in labour (Andrews 1981; Kariminia 2004), and one due to participants not specifically having an OP/OT malposition (Zhang 2017).

Risk of bias in included studies

We assessed risk of bias from full-text versions of all eight included trials (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005) (see Figure 3 and Figure 4). All included trials were at risk of performance bias due to unblinding (Figure 3; Figure 4). We assessed one trial as high risk for allocation bias. High risk of reporting bias applied to two trials.

Figure 3. Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies

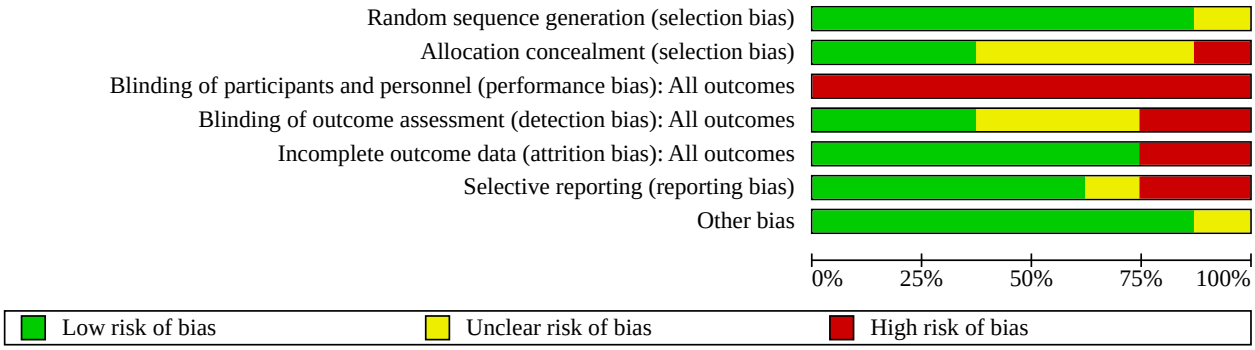
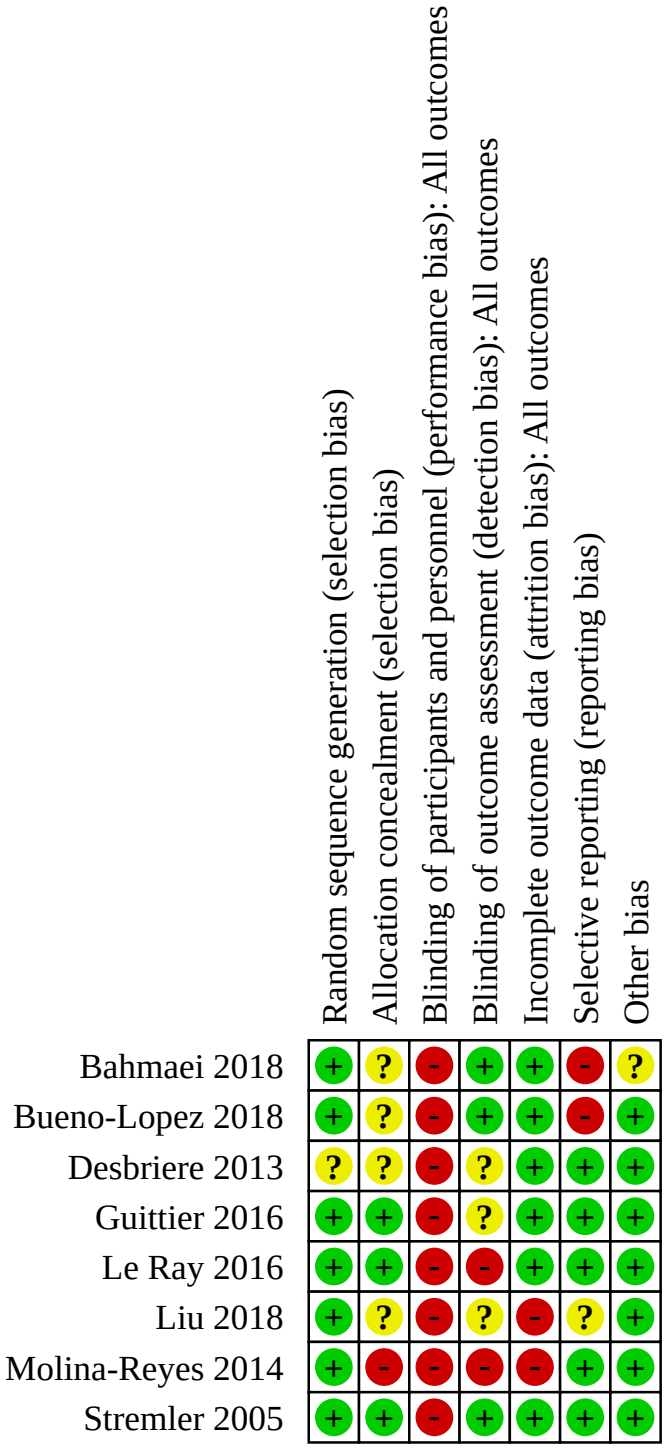


Figure 4. Figure 4. Risk of bias summary: review authors' judgements about each risk of bias item for each included study



Allocation

We assessed seven trials as being at low risk of selection bias (Bahmaei 2018; Bueno-Lopez 2018; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005), reporting use of centralised, adequate random sequencing (Bahmaei 2018; Bueno-Lopez 2018; Guittier 2016; Le Ray 2016; Molina-Reyes 2014; Stremler 2005), with permutations (Guittier 2016; Le Ray 2016; Stremler 2005), or 1:1 ratio (Molina-Reyes 2014); or use of simple allocation using a random digit table size 300 in time order (Liu 2018). We judged Desbriere 2013 to be at unclear risk of selection bias because, although it used permutated blocks of four, it provided no details on the source of the random sequence. We judged Molina-Reyes 2014 to be at high risk for allocation concealment as the midwife (possibly providing care) consulted the list of random numbers. The remaining four trials did not report a method for concealing allocation, such as use of an independent person responsible for accessing the randomisation software or random digit table and whether the random digit table was visible to staff (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Liu 2018). We rated these as being at unclear risk of bias.

Blinding

Given the nature of the intervention (maternal posture in labour) and comparison (use of another maternal posture), it was not possible for participants or caregivers, midwives, and obstetricians to be blinded to the allocated groups, and thus we judged the risk of performance bias to be high for all eight included trials. We judged three trials to be at low risk of detection bias due to blinding of outcome assessors (Bueno-Lopez 2018; Stremler 2005; Bahmaei 2018). We assessed three trials to be at unclear risk of detection bias: in two trials, due to the midwife or obstetrician involved in care performing the ultrasound scan before operative births and collecting fetal position at birth for two trials (Desbriere 2013; Guittier 2016); and in one trial, there was no mention of whether outcome assessors were blinded (Liu 2018). We judged two trials to be at high risk of detection bias due to lack of blinding of the midwives and obstetricians who assessed outcomes and randomly assigned groups (Le Ray 2016; Molina-Reyes 2014). Five of the seven trials that reported malposition after the intervention assessed fetal position by ultrasound (Bueno-Lopez 2018; Guittier 2016; Le Ray 2016; Liu 2018; Stremler 2005), undertaken by either the midwife or obstetrician providing care or a colleague who may have been told the allocation. Therefore, there is the potential for subjectivity regarding determination of occiput-transverse from occiput-anterior parameters. Subjectivity may also apply for the outcome fetal position at birth (Desbriere 2013; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005), which was prospectively collected by the midwife providing care in labour in most cases.

Incomplete outcome data

We considered the majority (six) of the trials to be at low risk of attrition bias, with minimal or no losses to follow-up (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Stremler 2005). In one of these trials, information for one participant in the intervention group was lost (Bueno-Lopez 2018).

We judged the two remaining trials to be at high risk of attrition bias due to incomplete outcome data and no intention-to-treat analysis (Liu 2018; Molina-Reyes 2014). In Molina-Reyes 2014, 11 participants (14.5%) were lost to follow-up in the intervention group and no participants lost from the control group. In Liu 2018, there was loss to follow-up in both groups: nine (7.8%) in the study group and seven (6.25%) in the control group.

Selective reporting

We judged five of the eight trials to be at low risk of selective reporting bias as all outcomes in the study methods were reported (Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005).

We judged two trials to be at high risk of selective reporting bias (Bueno-Lopez 2018; Bahmaei 2018). The Bueno-Lopez 2018 trial did not report duration of first and second stage labour despite it being listed as an outcome in their trial protocol, and although intention-to-treat analysis was intended, one set of notes was lost. The Bahmaei 2018 trial only reported two of the 10 trial outcomes (labour pain intensity and maternal satisfaction); it did not report the primary outcome (correction of OP head position). We did not locate any other publications of the outcomes. We judged Liu 2018 to have an unclear risk of selective reporting bias due to no pre-trial registration or protocol; therefore, it was unclear if all planned outcomes were reported.

Other potential sources of bias

We assessed seven of the eight trials as having no other sources of potential bias (Bueno-Lopez 2018; Desbriere 2013; Guittier 2016; Le Ray 2016; Liu 2018; Molina-Reyes 2014; Stremler 2005).

We judged Bahmaei 2018 to have an unclear risk of bias from other potential sources due to an absence of intervention group totals for pain intensity.

Effects of interventions

See: **Summary of findings 1** Hands and knees posture compared to other postures for fetal malposition in labour - maternal outcomes; **Summary of findings 2** Hands and knees posture compared to other postures for fetal malposition in labour - infant outcomes; **Summary of findings 3** Lateral postures compared to other postures for fetal malposition in labour - maternal outcomes; **Summary of findings 4** Lateral postures compared to other postures for fetal malposition in labour - infant outcomes

1. Hands and knees posture comparison

Four trials used the hands and knees posture (Bahmaei 2018; Guittier 2016; Molina-Reyes 2014; Stremler 2005).

Primary outcomes

Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Use of the hands and knees posture may result in little to no difference on the outcome operative birth but the evidence is uncertain (average risk ratio (RR) 1.14, 95% confidence interval (CI) 0.87 to 1.50; Tau^2 = 0.02, Chi^2 = 2.95 (P = 0.23), I^2 = 32%; 3 trials (Guittier 2016; Molina-Reyes 2014; Stremler 2005), 721 women; low-certainty evidence; Analysis 1.1). All trials included both nulliparous and multiparous women. Guittier 2016 had a minimum intervention period of 10 minutes compared to 30 minutes in the other two trials. Molina-Reyes 2014 did not confirm fetal malposition at randomisation by ultrasound scan for all women; instead, this was assessed by two vaginal examinations. The Bahmaei 2018 trial did not report operative birth.

No trials reported operative birth by any of the pre-specified subgroups.

Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)

None of the four trials in the hands and knees posture comparison reported on death or serious neonatal morbidity.

Secondary outcomes

Short-term maternal outcomes

Fetal malposition (OP/OT) after the intervention

The evidence is uncertain that use of the hands and knees posture compared to other postures results in a reduction in the outcome fetal malposition (OP/OT) after the intervention because the CI includes the line of no effect (RR 0.93, 95% CI 0.87 to 1.00; Chi^2 = 0.38 (P = 0.83), I^2 = 0%; 3 trials (Guittier 2016; Molina-Reyes 2014; Stremler 2005), 688 women; Analysis 1.2). The Bahmaei 2018 trial did not report this outcome.

Duration of labour (in hours)

The evidence suggests use of the hands and knees posture has little or no effect on the duration of labour compared to the use of other posture (mean difference (MD -0.26 hours, 95% CI -0.75 to 0.22; Chi^2 = 1.42 (P = 0.49), I^2 = 0%; 3 trials (Guittier 2016; Molina-Reyes 2014; Stremler 2005), 721 women; Analysis 1.3). We converted data for Stremler 2005 from mean and interquartile range to mean and standard deviation. Again, the remaining trial did not report on duration of labour (Bahmaei 2018).

Oxytocin augmentation

There may be little or no difference in the requirement for oxytocin augmentation of labour in women using hands and knees posture compared to other postures (RR 0.86, 95% CI 0.57 to 1.30; 147 women; Analysis 1.4), however, the evidence is from only one trial (Stremler 2005). Three trials in this comparison did not report on oxytocin use during labour (Bahmaei 2018; Guittier 2016; Molina-Reyes 2014).

Pain score (as defined by trialists using standardised tools)

The evidence is uncertain that the hands and knees posture compared to other postures results in a reduction in pain score because the CI includes the line of no effect (RR 0.41, 95% CI 0.17 to 1.01; 110 women; Analysis 1.5), however, the evidence is from only one trial (Molina-Reyes 2014). The authors defined pain after the intervention as either major, minor, or equal to pre-intervention pain. For this review, we report major pain. We could not use pain score data provided in Stremler 2005 because they gave no standard deviation, and in Bahmaei 2018 because they provided no totals. The use of hands and knees posture may result in little or no difference in mean pain score compared to other postures (MD 0.05, 95% CI -0.29 to 0.39; 439 women; Analysis 1.6); however, the evidence was from one trial (Guittier 2016). Pain was reported as median and range which we converted to mean and standard deviation. There were likely more events of improved comfort in the hands and knees posture compared to other postures (RR 1.75, 95% CI 1.25 to 2.46; P = 0.001; 1 trial (Guittier 2016), 411 women; Analysis 1.7). Another study that reported increased comfort only provided percentages (Molina-Reyes 2014), so we could not include their data in the meta-analysis.

Epidural use

The hands and knees posture compared to other postures may have little or no effect on epidural use, but the evidence is very uncertain (average RR 0.74, 95% CI 0.41 to 1.31; Tau^2 = 0.13, Chi^2 = 3.69 (P = 0.05), I^2 = 73%; 2 trials (Molina-Reyes 2014; Stremler 2005), 282 women; very low-certainty evidence; Analysis 1.8). Molina-Reyes 2014 had 14.5% attrition and did not sonographically confirm malposition at randomisation. Two trials in the hands and knees comparison did not report epidural use (Bahmaei 2018; Guittier 2016).

Occipito-posterior/transverse position at birth

The hands and knees posture may result in little or no difference in the rate of OP/OT position at birth compared to other postures (RR 0.81, 95% CI 0.55 to 1.20; Chi^2 = 0.22, I^2 = 0%; 2 trials (Molina-Reyes 2014; Stremler 2005), 257 women; Analysis 1.9). Two trials did not report on OP/OT position at birth, (Bahmaei 2018; Guittier 2016).

Caesarean section

The evidence is uncertain about the effect of the hands and knees posture compared to other postures on caesarean section because the CI is compatible with a range of effects encompassing both a small benefit but also appreciable harm (RR 1.34, 95% CI 0.96 to 1.87; Chi^2 = 2.48 (P = 0.29), I^2 = 19%; 3 trials (Guittier 2016; Molina-Reyes 2014; Stremler 2005), 721 women; low-certainty evidence; Analysis 1.10). One trial in this comparison did not report caesarean section (Bahmaei 2018).

Instrumental vaginal birth

The hands and knees posture may result in little or no difference in instrumental vaginal birth compared to other postures, but the evidence is very uncertain (average RR 1.04, 95% CI 0.57 to 1.90; Tau^2 = 0.18, Chi^2 = 5.99 (P = 0.05)), I^2 = 67%; 3 trials (Guittier 2016; Molina-Reyes 2014; Stremler 2005), 721 women; very low-certainty evidence; Analysis 1.11). Heterogeneity may be explained in part by the 14.5% attrition in one trial (Molina-Reyes 2014), and the short duration of intervention (minimum 10 minutes) in the Guittier 2016 trial. After removing Molina-Reyes 2014 in a sensitivity analysis, heterogeneity was reduced to I^2 = 29% but did not change the result. One trial did not report this outcome (Bahmaei 2018).

Episiotomy

The evidence is very uncertain about the effect of the hands and knees posture compared to other postures on the outcome episiotomy because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 1.15, 95% CI 0.70 to 1.91; 147 women; Analysis 1.12). However, the evidence is from only one trial. Three trials did not report this outcome (Bahmaei 2018; Guittier 2016; Molina-Reyes 2014).

Severe perineal tears (third degree or higher, as defined by trialists)

The evidence is very uncertain about the effect of the hands and knees posture compared to other postures on women sustaining severe perineal tears (third degree or higher) because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.88, 95% CI 0.03 to 22.30; Tau^2 = 3.74, Chi^2 = 3.10 (P = 0.08), I^2 = 68%; 2 trials (Guittier 2016; Stremler 2005), 586 women; very low-certainty evidence; Analysis 1.13). One trial was a multicentre trial across 13

countries which may differ by practice and therefore may partially explain the heterogeneity (Stremler 2005). Two trials did not report this outcome (Bahmaei 2018; Molina-Reyes 2014).

Maternal satisfaction (as defined by trialists)

The hands and knees posture compared to other postures may result in little or no difference in maternal satisfaction, but the evidence is very uncertain (average RR 1.02, 95% CI 0.68 to 1.54; Tau^2 = 0.08, Chi^2 = 4.95 (P = 0.08), I^2 = 60%; 3 trials, 350 women; very low-certainty evidence; Analysis 1.14). Heterogeneity may be partially explained by 14.5% attrition in one trial (Molina-Reyes 2014), or differences in the definition of satisfaction. For example, satisfaction was defined as: satisfaction with the labour position measured at 6 cm (Bahmaei 2018); satisfaction with the birth experience measured by the Care in Obstetrics: Measure for Testing Satisfaction (COMFORTS) Scale (Molina-Reyes 2014); and satisfaction in terms of women using the hands and knees posture after the one-hour study period (Stremler 2005). One trial reported maternal satisfaction according to personal control during labour and birth, using the Labour Agentry Scale (Stremler 2005), for which there was little or no difference between the hands and knees posture group and the other postures group (MD -0.54, 95% CI -4.13 to 3.05; 138 women; Analysis 1.15). One trial did not report maternal satisfaction (Guittier 2016).

Other secondary maternal outcomes

No trials in the hands and knees comparison reported occipito-transverse arrest, postpartum haemorrhage, postnatal depression, any breastfeeding on discharge, or the long-term outcomes of operative pelvic floor repair post discharge or post-traumatic stress referrals.

Neonatal outcomes

Apgar scores less than seven at five minutes

The evidence is very uncertain about the effect of the hands and knees posture compared to other postures on the outcome Apgar score less than seven at five minutes because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 0.71, 95% CI 0.21 to 2.34; Chi^2 = 0.81 (P = 0.37), I^2 = 0%; 2 trials (Guittier 2016; Stremler 2005), 586 women and their babies; very low-certainty evidence; Analysis 1.16). Two trials did not report this outcome (Bahmaei 2018; Molina-Reyes 2014).

Birth trauma (as defined by trialists)

There were no events of birth trauma in the only trial reporting this outcome (Stremler 2005).

Other secondary neonatal outcomes

No trials in the hands and knees comparison reported death (stillbirth or death of liveborn infant), admission to neonatal intensive care, neonatal encephalopathy, need for respiratory support, neonatal jaundice requiring phototherapy, increased cord lactates or low pH, or the long-term outcome of disability including developmental delay.

2. Lateral posture comparison

Five trials used lateral postures (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018). Comparisons 3 and 4 are sub-comparisons of this lateral posture comparison.

Primary outcomes

Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Use of the lateral posture may have little or no effect on caesarean section compared to use of other postures but the evidence is uncertain (average RR 0.72, 95% CI 0.43 to 1.19; Tau^2 = 0.21, Chi^2 = 19.43 (P = 0.0002), I^2 = 85%; 4 trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018), 871 women; low-certainty evidence; Analysis 2.1).Heterogeneity may be explained by one trial timing the intervention closer to birth (Liu 2018), and two trials using lateral postures on the same side as the fetus (Bueno-Lopez 2018; Desbriere 2013), whilst the other two trials used lateral postures on the opposite side to the fetus (Liu 2018; Le Ray 2016). One trial did not report on operative birth (Bahmaei 2018).

Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)

The evidence is very uncertain about the effect of lateral postures compared to other postures on the outcome serious neonatal morbidity because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 1.41, 95% CI 0.64 to 3.12; Chi^2 = 0.41 (P = 0.52), I^2 = 0%; 3 trials (Le Ray 2016; Liu 2018; Desbriere 2013), 752 women and their babies; very low-certainty evidence; Analysis 2.13). Two of the trials reported admission to neonatal intensive care for this outcome (Le Ray 2016; Desbriere 2013). One trial reported no deaths in either group (Liu 2018). Two trials in the lateral comparison did not report serious neonatal morbidity (Bahmaei 2018; Bueno-Lopez 2018).

Secondary outcomes

Short-term maternal outcomes

Fetal malposition (OP/OT) after the intervention

The evidence is very uncertain if lateral postures compared to other postures may reduce the outcome fetal malposition after the intervention because the CI is compatible with both appreciable benefit and also no effect (average RR 0.70, 95% CI 0.46 to 1.08; Tau^2 = 0.15, Chi^2 = 22.08 (P < 0.001), I^2 = 86%; 4 trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018), 864 women; Analysis 2.2). The heterogeneity is not explained by whether same-side or contralateral side was used: separate comparisons for same-side or contralateral side posture show similar results. However, one trial timed the intervention in late labour and measured the outcome 60 minutes later when women were more likely to have entered the second stage (Liu 2018), when counter pressure from the pelvic floor may have aided fetal rotation. One trial did not report this outcome (Bahmaei 2018).

Duration of labour (in hours)

The evidence suggests use of lateral posture may result in little or no difference in the duration of labour compared to other postures (average MD -0.36, 95% CI -1.23 to 0.50; Tau^2 = 0.31, Chi^2 = 4.87 (P = 0.03), I^2 = 79%; 2 trials (Desbriere 2013; Liu 2018), 430 women; Analysis 2.3). The two trials used same-side-lateral, and contralateral postures, respectively, possibly explaining the heterogeneity. Three trials did not report on duration of labour, including one trial of semi-prone lateral posture (Bahmaei 2018), one trial of same-side-as-fetus lateral posture (Bueno-Lopez 2018), and one trial of contralateral posture (Le Ray 2016).

Oxytocin augmentation

Oxytocin augmentation in labour was probably no different for women in the lateral posture group compared to women in the other postures group (RR 0.93, 95% CI 0.85 to 1.02; 220 women; Analysis 2.4). However, the evidence is from only one trial (Desbriere 2013). Four trials did not report oxytocin augmentation (Bahmaei 2018; Bueno-Lopez 2018; Le Ray 2016; Liu 2018).

Pain score (as defined by trialists using standardised tools)

There was little or no difference in pain score, measured one hour after randomisation by visual analogue scale, for women using lateral postures compared to other postures (MD 0.10, 95% CI -0.28 to 0.48; 322 women; Analysis 2.5). However, the evidence was from only one trial (Le Ray 2016). Four trials in this comparison did not report on pain score (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Liu 2018).

Occipito-posterior/transverse position at birth

Lateral postures may have little or no effect on the incidence of OP/OT position at birth, but the evidence is very uncertain (average RR 0.63, 95% CI 0.25 to 1.60; $Tau^2 = 0.59$, $Chi^2 = 15.31$ (P < 0.001), $I^2 = 87\%$; 3 trials (Desbriere 2013; Le Ray 2016; Liu 2018), 749 participants; Analysis 2.6). Heterogeneity may be explained in part by one trial, Liu 2018, timing the intervention late in labour when the effect may have been measured closer to the time of the intervention. Furthermore, whilst all trials performed manual rotations, Liu 2018 performed manual rotation in all cases if postural correction was not successful by 60 minutes, but Le Ray 2016 only performed manual rotation prior to instrumental vaginal deliveries, and Desbriere 2013 only performed two manual rotations and reported these as persistent OP according to their intention-to-treat protocol. Two trials did not report OP/OT position at birth (Bahmaei 2018; Bueno-Lopez 2018).

Caesarean section

Lateral postures may have little or no effect on caesarean section compared to other postures (average RR 0.78, 95% CI 0.44 to 1.39; $Tau^2 = 0.21$, $Chi^2 = 8.33$ (P = 0.04), $I^2 = 64\%$; 4 trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018, 871 women; low-certainty evidence; Analysis 2.7), but the evidence is uncertain. An even mix of study interventions involved hip hyperflexion greater than 90 degrees versus equal to 90 degrees which did not translate into different results amongst the individual studies. However, one trial randomised women in late labour (Liu 2018), which may in part account for the heterogeneity. One trial did not report caesarean section (Bahmaei 2018).

Instrumental vaginal birth

Lateral postures may have little or no effect on instrumental vaginal birth compared to other postures (average RR 0.73, 95% CI 0.39 to 1.36; $Tau^2 = 0.29$, $Chi^2 = 12.26$ (P = 0.007), $I^2 = 76\%$; 4 trials (Bueno-Lopez 2018; Desbriere 2013, Le Ray 2016; Liu 2018), 871 women; low-certainty evidence; Analysis 2.8), but the evidence is uncertain. Heterogeneity may be explained by one trial (Liu 2018), which randomised late in labour, whereby the outcome was measured closer to effect from the intervention. After removing Liu 2018 in a sensitivity analysis, heterogeneity was removed ($I^2 = 0\%$) but the result was unchanged. One trial did not report this outcome (Bahmaei 2018).

Episiotomy

The lateral posture may result in little or no difference in risk of an episiotomy compared to other postures (RR 0.94, 95% CI 0.74 to 1.20; $Chi^2 = 1.59$ (P = 0.45), $I^2 = 0\%$; 3 trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016), 609 women; Analysis 2.9). Two trials did not report this outcome (Bahmaei 2018; Liu 2018).

Severe perineal tears (third degree or higher, as defined by trialists)

The evidence is very uncertain about the effect of lateral postures compared to other postures on the outcome severe perineal tears because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 0.66, 95% CI 0.17 to 2.48; $Chi^2 = 0.92$ (P = 0.63), $I^2 = 0\%$); 3 trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016), 609 women; very low-certainty evidence; Analysis 2.10). Two trials did not report on this outcome (Bahmaei 2018; Liu 2018).

Postpartum haemorrhage (as defined by trialists)

The evidence is very uncertain about the effect of lateral postures compared to other postures on the outcome postpartum haemorrhage because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and includes only one trial (Le Ray 2016) (RR 0.90, 95% CI 0.48 to 1.70; 322 women; very low-certainty evidence; Analysis 2.11). Four trials did not report this outcome (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Liu 2018).

Maternal satisfaction (as defined by trialists)

The use of lateral postures may result in little or no difference in maternal satisfaction compared to use of other postures, but the evidence is uncertain (RR 0.96, 95% CI 0.84 to 1.09; $Chi^2 = 0.81$ (P = 0.37), $I^2 = 0\%$; 2 trials (Bahmaei 2018; Le Ray 2016), 451 women; low-certainty evidence; Analysis 2.12). In the Bahmaei 2018 study, the intervention group had two arms: hands and knees posture, as reported in Comparison 1, and lateral (semi-prone) posture, as reported here. One trial only reported P values for two questions using the Mackey Scale (Bueno-Lopez 2018), and two trials did not report this outcome (Desbriere 2013; Liu 2018).

Other secondary maternal outcomes

No trials in the lateral posture comparison reported occipito-transverse arrest, epidural use, postnatal depression, any breastfeeding on discharge, and the long-term outcomes of operative pelvic floor repair post discharge or post-traumatic stress referrals. For one trial (Bueno-Lopez 2018), having an epidural was an inclusion criteria, and in another, the vast majority of women had an epidural prior to randomisation (Desbriere 2013).

Neonatal outcomes

Death (stillbirth or death of liveborn infant)

One trial with 210 participants reported no deaths in either group in the lateral posture comparison (Liu 2018), but the evidence is very uncertain.

Apgar scores less than seven at five minutes

The evidence is very uncertain about the effect of lateral postures compared to other postures on the outcome Apgar score less than seven at five minutes because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also

harm (RR 0.25, 95% CI 0.03 to 2.24; 1 trial, 322 women and their babies; very low-certainty evidence; Analysis 2.14), includes only one trial (Le Ray 2016), and few events. Four trials did not report this outcome (Bahmaei 2018; Bueno-Lopez 2018; Desbriere 2013; Liu 2018).

Admission to neonatal intensive care

The evidence is very uncertain about the effect of lateral postures compared to other postures on the outcome admission to neonatal intensive care because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 1.41, 95% CI 0.64 to 3.12; Chi^2 = 0.41 (P = 0.52), I^2 = 0%; 2 trials (Desbriere 2013; Le Ray 2016), 542 women and their babies; very low-certainty evidence; Analysis 2.15). Three trials in this comparison did not report on this outcome (Bahmaei 2018; Bueno-Lopez 2018; Liu 2018).

Birth trauma (as defined by trialists)

One trial reported one event of birth trauma (Desbriere 2013): a scalp injury following a ventouse extraction for an infant in the other posture group (RR 0.33, 95% CI 0.01 to 8.09; 220 women and their babies; Analysis 2.16). However, there were insufficient data to determine the effect of posture on this outcome. Four trials did not report this outcome (Bahmaei 2018; Bueno-Lopez 2018; Le Ray 2016; Liu 2018).

Other secondary neonatal outcomes

No trials in the lateral posture comparison reported on neonatal encephalopathy, need for respiratory support, neonatal jaundice requiring phototherapy, increased lactates or low pH. One trial measured mean pH, reported as P values (Bueno-Lopez 2018). Four trials did not report this outcome (Bahmaei 2018; Desbriere 2013; Le Ray 2016; Liu 2018). No trials in the lateral posture comparison reported the long-term outcome of disability including developmental delay.

3. Same-side-as-fetus lateral posture comparison

Two trials used same-side-as-fetus lateral posture (Bueno-Lopez 2018; Desbriere 2013).

Primary outcomes

Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Same-side lateral posture may have little or no effect on the rate of operative birth, compared to other postures (average RR 0.88, 95% CI 0.64 to 1.21; Tau^2 = 0.02, Chi^2 = 1.54 (P = 0.21), I^2 = 35%; 2 trials, 339 women; Analysis 3.1), but the evidence is very uncertain. The two trials differed by intervention. Bueno-Lopez 2018 compared a same-side lateral posture in which the upper leg was slightly internally rotated (modified Sims) and after fetal rotation, women adopted free postures. Desbriere 2013 compared a series of lateral postures on the same side as the fetus, depending on the station of the fetal head, and after fetal rotation, adopted supine posture.

Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy,or as defined by trialists)

The evidence is very uncertain about the effect of same-side lateral posture compared to other postures on the outcome serious neonatal morbidity because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and the evidence was from one trial reporting infants' requirement for admission to neonatal intensive care (Desbriere 2013) (RR 2.00, 95% CI 0.51 to 7.80; 220 women and their babies; Analysis 3.10). One trial did not report on this outcome (Bueno-Lopez 2018).

Secondary outcomes

Short-term maternal outcomes

Fetal malposition (OP/OT) after the intervention

Use of same-side lateral posture may have little or no effect on fetal malposition (OP/OT) after the intervention compared to other postures (average RR 0.73, 95% CI 0.49 to 1.07; Tau^2 = 0.04, Chi^2 = 1.95 (P = 0.16), I^2 = 49%; 2 trials, 339 women; Analysis 3.2), but the evidence is very uncertain. However, the trials differed in that Bueno-Lopez 2018 confirmed anterior rotation by scan whereas Desbriere 2013 only reported persistent fetal position at birth. Though Desbriere 2013 had women in the study group adopt the supine position after anterior rotation, they did not report on malposition just prior to this.

Duration of labour (in hours)

Use of same-side lateral posture likely results in little or no difference in duration of labour compared to the use of other postures, though the evidence is from only one trial (Desbriere 2013) (MD 0.13, 95% CI -0.56 to 0.82; 220 women; Analysis 3.3). Duration of labour was reported as median and interquartile range which we converted into mean and standard deviation. One trial did not report this outcome (Bueno-Lopez 2018).

Oxytocin augmentation

Only one trial reported oxytocin augmentation of labour (Desbriere 2013), in which there was likely little or no difference between the same-side lateral posture and other posture groups (RR 0.93, 95% CI 0.85 to 1.02; 220 women; Analysis 3.4). The Bueno-Lopez 2018 trial did not report on oxytocin augmentation.

Occipito-posterior/transverse position at birth

OP/OT position at birth was only reported in one trial of 220 women (Desbriere 2013), in which the same-side lateral posture may have had little or no effect on OP/OT position at birth compared to other postures (RR 0.92, 95% CI 0.57 to 1.50; Analysis 3.5). One study did not report fetal position at birth (Bueno-Lopez 2018).

Caesarean section

The evidence is very uncertain about the effect of same-side lateral posture compared to other postures on the outcome caesarean section because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.75, CI 0.33 to 1.69; Tau^2 = 0.24, Chi^2 = 3.25 (P = 0.07), I^2 = 69%; 2 trials, 339 women; Analysis 3.6). The two trial interventions differed, which possibly explains the heterogeneity. Bueno-Lopez 2018 included slight internal rotation of the upper leg and Desbriere 2013 had women adopt a supine posture after fetal rotation occurred.

Instrumental vaginal birth

Rates of instrumental vaginal births may be no different between the same-side lateral posture groups and other posture groups (RR 1.01, 95% CI 0.66 to 1.53; I^2 = 0%; 2 trials, 339 women; Analysis 3.7).

Episiotomy

The number of women receiving an episiotomy may be no different using same-side lateral postures compared to other postures (RR 1.05, 95% CI 0.77 to 1.41; I^2 = 0%; 2 trials, 339 women; Analysis 3.8).

Severe perineal tears (third degree or higher, as defined by trialists)

The evidence is very uncertain about the effect of same-side lateral postures compared to other postures on the outcome severe perineal tears because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 0.43, 95% CI 0.06 to 2.89; Chi^2 = 0.62 (P = 0.43), I^2 = 0%; 2 trials, 339 women; Analysis 3.9).

Other secondary maternal outcomes

Neither trial in the same-side lateral posture comparison reported pain score, occipito-transverse arrest, postpartum haemorrhage, epidural use, maternal satisfaction, postnatal depression, any breastfeeding on discharge, or the long-term outcomes of operative pelvic floor repair post discharge or post-traumatic stress referrals. Both trials reported epidural use prior to the intervention (Bueno-Lopez 2018; Desbriere 2013). In the Bueno-Lopez 2018 trial, all included women had epidural analgesia. In the Desbriere 2013 trial, 103 of 110 women in the intervention group and 105 of 110 women in the control group had an epidural.

Neonatal outcomes

Death (stillbirth or death of liveborn infant)

Neither trial in the same-side lateral posture comparison reported neonatal death.

Apgar scores less than seven at five minutes

Neither trial in the same-side-lateral posture comparison reported Apgar scores less than seven at five minutes.

Admission to neonatal intensive care

The evidence is very uncertain about the effect of same-side lateral postures compared to other postures on the outcome admission to neonatal intensive care because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and the evidence was from one trial with few events (Desbriere 2013) (RR 2.00, 95% CI 0.51 to 7.80; 220 women and their babies; Analysis 3.11). The Bueno-Lopez 2018 trial did not report on this outcome.

Birth trauma (as defined by trialists)

Only the Desbriere 2013 trial reported birth trauma, with just one incident of infant scalp trauma following a ventouse extraction delivery in the other posture group (RR 0.33, 95% CI 0.01 to 8.09; 220 women and their babies; Analysis 3.12). Therefore, there were insufficient data to determine the effect of posture on this outcome. One trial did not report this outcome (Bueno-Lopez 2018).

Other secondary neonatal outcomes

No trials in the same-side lateral posture comparison reported death (stillbirth or death of liveborn infant), Apgar scores less than seven at five minutes, neonatal encephalopathy, need for respiratory support, neonatal jaundice requiring phototherapy, increased cord lactates or low pH, and the long-term outcome of disability including developmental delay.

4. Contralateral (opposite site to fetus) posture comparison

Two trials used a contralateral posture (Le Ray 2016; Liu 2018).

Primary outcomes

Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

The evidence is very uncertain about the effect of a contralateral posture compared to other postures on the outcome operative birth because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.49, 95% CI 0.08 to 2.85; Tau^2 = 1.53, Chi^2 = 18.63 (P < 0.001), I^2 = 95%; 2 trials, 532 women; Analysis 4.1). Whilst both trials involved hip hyperflexion greater than 90 degrees, Liu 2018 randomised late in labour and thus applied the intervention closer to the time of birth.

Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy, or as defined by trialists)

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome serious neonatal morbidity because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (RR 1.16, 95% CI 0.43 to 3.12; 2 trials, 532 women and their babies; Analysis 4.12). Le Ray 2016 reported admission to neonatal intensive care, and Liu 2018 reported no deaths in either group.

Secondary outcomes

Short-term maternal outcomes

Fetal malposition (OP/OT) after the intervention

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome fetal malposition (OP/OT) after the intervention because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.62, 95% CI 0.20 to 1.94; Tau^2 = 0.64, Chi^2 = 15.28 (P < 0.001), I^2 = 93%; 2 trials, 525 women; Analysis 4.2). The Liu 2018 study randomised women late in labour, when fetal rotation may have been aided by resistance of the pelvic floor in the second stage, which may explain the heterogeneity.

Duration of labour (in hours)

The contralateral posture (with extreme hip flexion) likely reduced the duration of labour by 46 minutes compared to other postures (MD -0.76, 95% CI -1.14 to -0.38; overall effect P < 0.001; 210 women; Analysis 4.3). However, the evidence was from only one trial (Liu 2018), so should be considered cautiously. One trial did not report duration of labour (Le Ray 2016).

Pain score (as defined by trialists using standardised tools)

Pain score was reported by only one trial (Le Ray 2016), which may have observed little or no difference in mean pain score between the two groups (contralateral posture and other posture) (MD 0.10, 95% CI -0.28 to 0.48; 1 trial; 322 women; Analysis 4.4). One trial did not report on pain score (Liu 2018).

Occipito-posterior/transverse position at birth

The evidence is very uncertain about the effect of contralateral posture compared to other postures on the outcome OP/OT

position at birth because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.50, 95% CI 0.08 to 2.89; $Tau^2 = 1.51$, $Chi^2 = 14.15$ ($P < 0.001$), $I^2 = 93\%$; 2 trials, 529 women; Analysis 4.5). The Liu 2018 trial attempted manual rotation on all women for whom postural correction was unsuccessful 60 minutes after randomisation, and the Le Ray 2016 trial performed manual rotation prior to instrumental vaginal birth.

Caesarean section

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome caesarean section because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.70, 95% CI 0.17 to 2.86; $Tau^2 = 0.83$, $Chi^2 = 4.45$ ($P = 0.03$), $I^2 = 78\%$; 2 trials, 532 women; Analysis 4.6). Whilst both trial interventions incorporated hip hyperflexion greater than 90 degrees, the Liu 2018 trial applied the intervention closer to the time of birth, and performed instrumental vaginal delivery or caesarean section if manual rotation was unsuccessful 60 minutes after the intervention. Manual rotation was performed successfully in six of 13 women in the study group but only one of 36 women in the control group. These factors may explain the heterogeneity seen in this comparison.

Instrumental vaginal birth

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome instrumental vaginal birth because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm (average RR 0.43, 95% CI 0.07 to 2.76; $Tau^2 = 1.66$, $Chi^2 = 11.49$ ($P < 0.001$), $I^2 = 91\%$; 2 trials, 532 women; Analysis 4.7). All women in the Liu 2018 trial with an unsuccessful postural correction received manual rotation 60 minutes after the intervention, whilst manual rotation was only performed in the Le Ray 2016 trial prior to instrumental vaginal birth; this difference may explain the heterogeneity.

Episiotomy

There may be little or no difference in women's risk of episiotomy using contralateral postures compared to other postures (RR 0.79, 95% CI 0.52 to 1.20; 270 women; Analysis 4.8); however, the evidence is from only one trial (Le Ray 2016). The Liu 2018 trial did not report on episiotomy.

Severe perineal tears (third degree or higher, as defined by trialists)

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome severe perineal tears because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and the evidence is from only one trial with very few events (Le Ray 2016) (RR 1.06, 95% CI 0.15 to 7.42; 270 women; Analysis 4.9). The Liu 2018 trial did not report on perineal tears.

Postpartum haemorrhage (as defined by trialists)

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome postpartum haemorrhage because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and evidence is from only one trial (Le Ray 2016) (RR 0.90, 95% CI 0.48 to 1.70; 322 women; Analysis 4.10). The Liu 2018 trial did not report on postpartum haemorrhage.

Maternal satisfaction (as defined by trialists)

Women using contralateral postures or other postures were likely equally satisfied in terms of comfort with their allocated posture; however, the evidence was from only one trial (Le Ray 2016) (RR 0.99, 95% CI 0.87 to 1.12; 322 women; Analysis 4.11). The Liu 2018 trial did not report maternal satisfaction.

Other secondary maternal outcomes

Neither trial in the contralateral posture comparison reported oxytocin augmentation, epidural use, occipito-transverse arrest, postnatal depression, any breastfeeding on discharge, and the long-term outcomes of operative pelvic floor repair post discharge and post-traumatic stress referrals.

Neonatal outcomes

Death (stillbirth or death of liveborn infant)

One trial with 210 participants reported no deaths in either group in the contralateral comparison (Liu 2018).

Apgar scores less than seven at five minutes

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome Apgar score less than seven at five minutes because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and the evidence is from only one trial (Le Ray 2016) (RR 0.25, 95% CI 0.03 to 2.24; 322 women and their babies; Analysis 4.13). The Liu 2018 trial reported Apgar scores inclusive of seven.

Admission to neonatal intensive care

The evidence is very uncertain about the effect of contralateral postures compared to other postures on the outcome admission to neonatal intensive care because the CI is compatible with a wide range of effects encompassing both appreciable benefit and also harm, and the evidence is from only one trial (Le Ray 2016) (RR 1.16, 95% CI 0.43 to 3.12; 322 women and their babies; Analysis 4.14). The Liu 2018 trial did not report neonatal admissions to intensive care.

Other secondary neonatal outcomes

Neither trial in the contralateral posture comparison reported on neonatal encephalopathy, need for respiratory support, neonatal jaundice requiring phototherapy, increased cord lactates or low pH, birth trauma, or the long-term outcome of disability including developmental delay.

DISCUSSION

Summary of main results

In this review, we included eight randomised trials of maternal posture reporting on 1766 women with fetal malposition in labour. We did not restrict inclusion of studies based on language. We had two included studies translated into English (Bahmaei 2018; Molina-Reyes 2014).

Hands and knees posture

Use of the hands and knees posture may have little or no effect on the primary maternal outcome operative birth (a composite outcome defined as caesarean section or instrumental vaginal birth), and for caesarean section alone, but the evidence is uncertain. Use of the hands and knees posture may have little or no effect on the secondary outcomes epidural use, instrumental vaginal birth, severe perineal tears, and maternal satisfaction, but the evidence is very uncertain (Summary of findings 1). The evidence is very uncertain about the effect of the hands and knees posture on Apgar score less than seven at five minutes (Summary of findings 2). No data were available for postpartum haemorrhage, serious neonatal morbidity, death (stillbirth or death of liveborn infant), admission to neonatal intensive care, neonatal encephalopathy, need for respiratory support, and neonatal jaundice requiring phototherapy.

Lateral postures

Use of lateral postures, including same-side and contralateral postures, may have little or no effect on the primary maternal outcome operative birth, whether a caesarean section or instrumental vaginal birth, and the secondary outcomes maternal satisfaction, caesarean section, and instrumental vaginal birth, but the evidence is uncertain. Use of lateral postures may have little or no effect on the secondary outcomes severe perineal tears and postpartum haemorrhage, but the evidence is very uncertain (Summary of findings 3). For the infant, the evidence is very uncertain about the effect of lateral postures on the primary outcome serious neonatal morbidity, and secondary outcomes Apgar score less than seven at five minutes, admission to neonatal intensive care, and death (stillbirth or death of liveborn infant) (Summary of findings 4). There were no data reported for epidural use, neonatal encephalopathy, need for respiratory support, and neonatal jaundice requiring phototherapy.

Little to no differences in effect were observed for the remaining maternal and infant secondary outcomes for which there were data; however, the evidence was uncertain. Each maternal posture comparison utilised a variety of comparators. This may have minimised the pooled treatment effect, especially where trial comparators had differing mechanisms of rotation. Differences by timing, duration, and posture may have also influenced the findings.

Overall completeness and applicability of evidence

Relevance to review question

The evidence from the meta-analysis on the effectiveness of maternal postures for fetal malpositon in labour remains inconclusive. Whether either of the broad posture categories adopted within this review - that is, hands and knees posture or lateral postures - generate mechanisms for fetal rotation, or subtle differences within the postures, such as hip hyperflexion or slight internal rotation of the upper leg, make a difference is unclear. None of the included trials reported data for the key review outcomes of occipito-transverse arrest, any breastfeeding at discharge, operative pelvic floor repair post discharge, post-traumatic stress referrals, neonatal encephalopathy, need for respiratory support, neonatal jaundice requiring phototherapy, increased lactates (as defined by trialists) or low pH (as defined by trialists), and disability including long-term developmental delay (as defined by trialists). Evidence was based on one trial for several outcomes or was only reported for some postures. Several trials had a short duration of intervention which may be insufficient time to assess the effectiveness of that posture in labour for fetal malposition. All trials but one reporting maternal satisfaction had both nulliparous and multiparous women; the exception was Bahmaei 2018.

None of the trials reported any data that we could use for the pre-specified subgroup comparisons or had other conditions that warranted the application of our pre-specified subgroup analysis. It is therefore not known whether different findings may have resulted from analyses of the planned subgroups of parity, body mass index (less than 25 versus greater than or equal to 25), birthweight (less than 90th centile versus greater than or equal to 90th centile), fetal position (left OP/OT versus right OP/OT), and level of care facility (primary versus secondary or tertiary facility), and malposition confirmed by ultrasound.

There were no trials of postures other than the hands and knees or lateral postures. Only one study utilised the semi-prone lateral posture and only reported on maternal satisfaction.

Findings in the context of current practice

It is possible that interventions of short duration early in labour could be susceptible to a recurrence of malrotation after cessation of the posture, and therefore impact on the outcome 'OP/OT position at birth'. Current guidelines recommend non-supine positions in labour and freedom of maternal position and movement throughout labour (World Health Organization 1996). The evidence from this review does not support a change to these recommendations. Two prospective cohort studies reported over two-thirds of fetuses malrotate during labour (Gardberg 1998; Lieberman 2005), although other studies report the contrary (Souka 2003; Akmal 2004). Whether the fetal spine is anterior or remains transverse after anterior rotation of the head may be a determining factor. Malrotation following postural correction may explain the substantial heterogeneity in all lateral posture comparisons containing the Liu 2018 trial which differed from the other trials by having randomisation late in labour, with use of the posture in the second stage of labour. One trial using contralateral posture, Le Ray 2016, and one trial using hands and knees posture, Guittier 2016, stopped the postural intervention before the second stage of labour, which may explain the lack of effect seen in these trials. Another trial using the same-side lateral posture did not report when women stopped using the posture (Desbriere 2013).

How trials reported maternal satisfaction varied, including satisfaction with the labour experience, satisfaction with the posture, and level of control in labour. Had all trials measured satisfaction with the posture, there may have been greater clarity on how women viewed use of posture for malposition in labour. The heterogeneity may relate to one study differing by parity. Nulliparous women who typically experience a longer labour may have less tolerance for discomfort using the hands and knees posture, which has been reported to lead to sore wrists, hips, ligaments, and back pain (Kariminia 2004).

Epidural use is an important outcome, considering women are more likely to experience backache with a fetal malposition (Stremler 2003). However, there was a paucity of data concerning

epidural use, partly due to women already having an epidural at randomisation.

Certainty of the evidence

The body of evidence is generated from eight trials reporting on 1766 women. Conclusions about the effectiveness of maternal posture to improve maternal and infant health following fetal malposition in labour are limited by insufficient sample sizes and too few trials able to provide data for many of the outcomes, except operative birth (lateral posture). Inconsistency due to substantial statistical heterogeneity was apparent for three outcomes within the hands and knees comparison (epidural use, instrumental vaginal birth, and maternal satisfaction), and two outcomes within the lateral posture comparison (operative birth (primary outcome) and caesarean section), limiting the certainty of the evidence.

Methodological limitations of the studies

Several trials had short periods for the intervention of only 30 to 60 minutes, with one trial having only a 10-minute minimum period (Guittier 2016). This could have potentially reduced the effect size for birth outcomes, considering the wide interval of time for confounding by other postures before the birth. One trial of the hands and knees posture assessed malposition in some women by clinical vaginal examination (Molina-Reyes 2014), known to be less accurate than ultrasound assessment (Souka 2003; Akmal 2004). This trial had a 14.5% attrition due to women being unable to maintain the posture following epidural analgesia. The trial compared the hands and knees posture to same-side lateral posture which both have hypotheses for rotation based on gravity, possibly neutralising effects. Due to the nature of labour care, all trials were unblinded, thus at high risk of performance bias. In one trial that used the contralateral posture (Liu 2018), successful manual rotation followed by eutocic birth occurred in six of 13 women in the posture group but only one of 36 women in the control group, suggesting risk of performance bias for the review's primary outcome operative birth.

Certainty of the evidence for hands and knees comparisons

The certainty of the evidence was low for all maternal outcomes in the hands and knees posture comparison except epidural use, instrumental vaginal birth, and severe perineal tears, which we judged to be of very low certainty (Summary of findings 1). We downgraded operative birth, epidural use, caesarean section, instrumental vaginal birth, and maternal satisfaction one level for serious limitations in study design due to a high risk of performance bias in all studies; one of the included studies was at high risk of selection bias, detection bias, attrition bias, and reporting bias (not intention-to-treat analysis). We downgraded severe perineal tears one level for serious risk of performance bias in both studies, and one level for serious imprecision due to low event rate and small sample size with very wide confidence interval; we downgraded all other outcomes one level for serious imprecision due to small sample size. We downgraded all outcomes except operative birth and caesarean section one level for serious inconsistency due to substantial unexplained statistical heterogeneity. There were no data available to report on postpartum haemorrhage. We judged the outcome Apgar scores less than seven at five minutes to be of very low-certainty evidence (Summary of findings 2), downgrading by one level due to risk of performance bias in all trials; selection bias, detection bias, attrition bias, and reporting bias (not intention-to-treat analysis) in one trial; and downgrading by two levels for very serious imprecision due to low event rate, small sample size, and very wide confidence interval.

Certainty of the evidence of lateral posture comparisons

For the lateral posture comparison, we assessed the certainty of the evidence as low for operative birth, caesarean section, instrumental vaginal birth, and maternal satisfaction; and very low for severe perineal tears and postpartum haemorrhage. We downgraded operative birth, caesarean section, and instrumental vaginal birth by one level for serious limitations in study design due to a high risk of performance bias in all studies, detection bias in one study, and reporting bias (not intention-to-treat analysis) in one study; and downgraded by one further level for serious inconsistency due to substantial unexplained statistical heterogeneity (Summary of findings 3). We downgraded severe perineal tears and postpartum haemorrhage by one level for imprecision due to low event rate, small sample size, and very wide confidence interval. We further downgraded one level for serious limitations in study design due to high risk of performance bias in all studies; detection bias in one study; and reporting bias in one study applied to severe perineal tears. We downgraded maternal satisfaction by one level for serious imprecision due to small sample size; and one level due to serious limitations in study design due to a high risk of performance bias in both studies, and detection bias in one study. We judged all infant outcomes reported to be of very low-certainty evidence (Summary of findings 4). We downgraded all outcomes one level for serious limitations in study design due to a high risk of performance bias in all studies. Detection bias in one study applied to the outcomes Apgar score less than seven at five minutes and admission to neonatal intensive care; and reporting bias (no intention-to-treat analysis) applied to the outcome death (stillbirth or death of liveborn infant). We downgraded by two further levels the outcomes serious neonatal morbidity, Apgar scores less than seven at five minutes, and admission to neonatal intensive care for very serious imprecision due to low event rate, small sample size, and very wide confidence intervals. We further downgraded the outcome death (stillbirth or death of liveborn infant) two levels for very serious imprecision due to it being a single small study with no events.

Potential biases in the review process

The review has the following strengths. We included all eligible relevant trials identified by the search and considered trustworthy. At least two review authors (JB and either JH, LL, BK or CC) agreed upon all data extraction and synthesis. At least two review authors held regular meetings, and all the review authors held monthly meetings, to reach agreement on the review's approach, such as organisation of comparisons, GRADE evaluations, interpretation of the results, and the implications for practice and research. The review author group sought a third opinion to reach agreement on risk of bias in two trials. In addition, the review benefits from author backgrounds in midwifery, obstetrics, general medicine, statistics, and clinical trials, providing contextual insight, for example, on the risk of performance bias in the clinical setting, and implications relevant to clinical practice and research.

However, the review needs to be considered in the light of some limitations. Three trials remain awaiting classification due to the need for further information from the trial authors. Despite searching, we found no email address for authors of two of these trials (Ou 1997; Lu 2001), and we have received no response as

yet from Wu 2001. We have received no response as yet to a request for additional information about randomisation method from Bahmaei 2018 (hands and knees comparison). Most of the trials had relatively small sample sizes; consequently, much of the evidence is uncertain due to imprecision.

Agreements and disagreements with other studies or reviews

The previous Cochrane Review of the use of hands and knees posture in labour compared with control posture analysed the data from Stremler 2005 (Hunter 2007). The review reported no differences in comparison of operative birth, persistent malposition including at delivery, perineal trauma and Apgar scores, similar to the findings in this review apart from the definition used for Apgar scores.

Two recently published systematic reviews provide meta-analyses assessing maternal posture to correct fetal malposition (Lee 2021; Levy 2021). The Levy 2021 review of trials of the hands and knees posture included pregnancy and labour trials but presented a subgroup analysis of women in labour. Lee 2021 assessed posture during the first stage of labour and included trials that used the hands and knees posture and trials using lateral postures. Lee 2021 hypothesised that both postures entail flexion of the thigh to 90 degrees or higher to the axis of the maternal spine, a mechanism by which the authors suggest pelvic diameters are increased, encouraging fetal rotation.

Our meta-analysis used random-effects analysis where heterogeneity exceeded 30%, compared to greater than 50% in the case of Lee 2021, and consistent use of random-effects analysis in the case of Levy 2021. Regardless of how these two systematic reviews differ from this Cochrane Review in terms of pooled participants, interventions, or statistical model, their findings chime with our findings that there was little to no difference between the posture and control groups in the pooled analysis for most outcomes.

Hands and knees comparison

Similar to Levy 2021, we observed little to no difference in caesarean section, instrumental vaginal delivery, OP/OT at birth, epidural use, severe perineal tears, and Apgar scores less than seven at five minutes. The Levy 2021 review included the Guittier 2016, Molina-Reyes 2014, and Stremler 2005 trials but also a pregnancy trial (Kariminia 2004).

Our observation of no difference in fetal malposition after use of the hands and knees posture chimes with both Lee 2021 (they included Guittier 2016 and Stremler 2005, but also Le Ray 2016 (contralateral posture)) and Levy 2021, who reported OA presentations were not increased after the intervention in a pre-specified subgroup analysis of women in labour at the time of the intervention (three trials were included: Guittier 2016; Molina-Reyes 2014; Stremler 2005). The persistence of malposition continued at birth, similar to the reviews by Levy 2021 and Lee 2021, though the latter added trials of lateral postures that involve hip flexion (Bueno-Lopez 2018, Desbriere 2013, and Liu 2018), as they considered that these simulate the pelvic shape in the hands and knees posture.

We observed little to no difference in the duration of labour between the hands and knees posture and other postures, contrary to evidence in Levy 2021 of a nearly 22 minutes' shorter labour, though they only included two trials - Kariminia 2004 and Stremler 2005 - the former a pregnancy trial.

Lateral postures comparison

Caesarean section was not significantly reduced following use of a lateral posture, consistent with Lee 2021, though they included four lateral posture trials (Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018), and three hands and knees posture trials (Guittier 2016; Hodnett 2013; Stremler 2005). Hodnett 2013 is a pilot trial of all women (OA and OP/OT fetuses). Similar to Lee 2021, we observed substantial heterogeneity, which remained in the separate comparisons for same-side lateral and contralateral postures in this review. Instrumental vaginal birth compared similarly with Lee 2021, who also showed substantial heterogeneity, though heterogeneity disappeared in the same-side lateral comparison in this review. Insufficient sample size was a factor in all lateral posture comparisons of caesarean section and instrumental vaginal birth in this review and in the Lee 2021 review.

Lateral posture did not reduce malposition after the intervention, consistent with Lee 2021 (whose trials included Le Ray 2016 and two trials of hands and knees posture (Guittier 2016; Stremler 2005)). However, we observed significant heterogeneity which they did not. This lack of significant correction of malposition continued to the birth, consistent with their report of no difference in the incidence of occipito-anterior position at birth (they included four lateral posture trials: Bueno-Lopez 2018; Desbriere 2013; Le Ray 2016; Liu 2018; and two hands and knees posture trials: Guittier 2016; Stremler 2005. Both reviews showed substantial heterogeneity.

This review reports little to no difference in duration of labour following use of lateral postures, although a shorter labour in the contralateral comparison was evidenced in the only included trial (Liu 2018). Comparisons with the Lee 2021 review are limited due to their report of first and second stage of labour separately, and because the majority of their sample comprised women adopting the hands and knees posture rather than a lateral posture (Guittier 2016, 439 women compared to Liu 2018, 210 women). Lee 2021 report a shorter first stage, though this may be influenced by one of their two included trials (Liu 2018), which incorporated manual rotation, vaginal assisted delivery, or caesarean section if postural correction of malposition was not achieved by 60 minutes.

Consistent with Lee 2021, we observed little to no difference in episiotomy and severe perineal tears (they included Bueno-Lopez 2018, Desbriere 2013, and Le Ray 2016, though for the latter outcome, they included two trials of hands and knees posture (Guittier 2016; Hodnett 2013); the latter is not specific to fetal malposition).

Similar to Lee 2021, we observed little to no effect on Apgar scores less than seven at five minutes in the only trial included, though Lee 2021 included one trial of lateral posture (Le Ray 2016), and two trials of hands and knees posture (Guittier 2016 and Hodnett 2013, which is not specific to fetal malposition).

AUTHORS' CONCLUSIONS

Implications for practice

We found low- and very low-certainty evidence which indicated that the use of hands and knees posture or lateral postures in women in labour with a fetal malposition may have little or no effect on health outcomes of the mother or her infant. There was insufficient data to be able to assess most of these comparisons. If women find the use of hands and knees or lateral postures in labour comfortable, there is no reason why they should not choose to use them.

Implications for research

Further research is needed on the use of hands and knees and lateral postures for women with a malposition in labour. This will improve precision through analyses of larger sample sizes, to be able to detect potentially important differences in interventions, such as semi-prone inclination and hip hyperflexion. Trials should include further assessment of semi-prone postures and/or same-side-as-fetus lateral postures with or without hip hyperflexion. Future trials that assess a longer intervention period or shorter interval between the intervention and birth, may result in greater frequency of events and provide further evidence that is needed. Consideration should be given to longer duration interventions, perhaps including a minimum duration per hour rather than per labour, and assessment of the use of maternal posture in the second stage of labour. Free posture comparators are preferable to avoid possible confounding from hypothetical mechanisms of rotation within a comparator. Ultrasonic confirmation of fetal malposition prior to randomisation and at assessment of fetal position post intervention by an assessor masked to treatment group should be considered.

How women felt about the postures needs further study as data are currently limited. Epidural use is an important outcome to report to provide contextual information on maternal pain scores. Future trials should report on all clinically relevant infant outcomes, including neonatal encephalopathy, need for respiratory support, and neonatal jaundice requiring phototherapy, as none of the current trials provided information about these. None of the existing trials have reported any longer-term outcomes pre-specified in this review, such as post-traumatic stress referrals, need for pelvic floor repair for the women, and childhood disability including developmental delay. These should be considered in future trials.

ACKNOWLEDGEMENTS

We acknowledge the support from Cochrane Pregnancy and Childbirth editorial team in Liverpool and the Australian and New Zealand Satellite of Cochrane Pregnancy and Childbirth.

We would like to acknowledge Regina Kulier for her contribution to the previous version of this review.

Jennifer Barrowclough wishes to thank the Liggins Institute, University of Auckland, Shundi Group Ltd, and Work Force New Zealand for financial support of her PhD.

This project was supported by the National Institute for Health Research (NIHR), via Cochrane Infrastructure funding to Cochrane Pregnancy and Childbirth. The views and opinions expressed herein are those of the authors and do not necessarily reflect those of the Evidence Synthesis Programme, the NIHR, National Health Service (NHS) or the Department of Health and Social Care.

As part of the pre-publication editorial process, this review has been commented on by three peers (an editor and two referees who are external to the editorial team), members of Cochrane Pregnancy and Childbirth's international panel of consumers and the Group's Statistical Adviser. The authors are grateful to the following peer reviewers for their time and comments: Dr Eleanor Jones, Institute of Applied Health Research, University of Birmingham; Jim Thornton, Emeritus Professor Obstetrics and Gynaecology, University of Nottingham.

We thank Faith Armitage for copy editing the final draft for publication.

REFERENCES

References to studies included in this review

Bahmaei 2018 *{published data only}*

* Bahmaei K, Iravani M, Moosavi P, Haghighizadeh MH. Effect of maternal positioning with occipito-posterior fetal position during labor on pain intensity and satisfaction of mothers. *Iranian Journal of Obstetrics, Gynecology and Infertility* 2018;**21**(5):66-73. [CENTRAL: CN-01645940] [EMBASE: 623723760]

IRCT2017082111360N3. The efficacy of maternal position in labor to correct occipito-posterior fetal position and delivery outcome. www.who.int/trialsearch/Trial2.aspx?TrialID=IRCT2017082111360N3 (first received 13 November 2017). [CENTRAL: CENTRAL: CN-01896062]

Bueno-Lopez 2018 *{published data only}*

* Bueno-Lopez V, Fuentelsaz-Gallego C, Casellas-Caro M, Falgueras-Serrano AM, Crespo-Berros S, Silvano-Cocinero AM, et al. Efficiency of the modified Sims maternal position in the rotation of persistent occiput posterior position during labor: a randomized clinical trial. *Birth: Issues in Perinatal Care* 2018;**45**(4):385-92. [CENTRAL: CN-01667845] [EMBASE: 624963359] [PMID: 29537658]

NCT02209090. Modified intrapartum sims position-related efficiency in correction of persistent foetal OP position [Randomised clinical trial: modified intrapartum maternal sims position-related efficiency in the correction of persistent foetal occipito-posterior position]. clinicaltrials.gov/show/NCT02209090 (first received 2 July 2014). [CENTRAL: CN-02025768]

Desbriere 2013 *{published data only}*

Desbriere R, Blanc J, Le Du R, Renner JP, Carcopino X, Loundou A, et al. Is maternal posturing during labor efficient in preventing persistent occiput posterior position? A randomized controlled trial. *American Journal of Obstetrics and Gynecology* 2013;**208**(1):60.e1-8. [CENTRAL: CN-00862750] [PMID: 23107610]

Guittier 2016 *{published data only}*

Guittier MJ, Othenin-Girard V, de Gasquet B, Irion O, Boulvain M. Authors' reply re: maternal positioning to correct occiput posterior fetal position during the first stage of the labour: a randomised controlled trial. *BJOG: an international journal of obstetrics and gynaecology* 2017;**124**(7):1124.

* Guittier MJ, Othenin-Girard V, de Gasquet B, Irion O, Boulvain M. Maternal positioning to correct occiput posterior fetal position during the first stage of labour: a randomised controlled trial. *BJOG: an international journal of obstetrics and gynaecology* 2016;**123**(13):2199-207. [CENTRAL: CN-01264392] [PMID: 26806596]

Guittier MJ, Othenin-Girard V, Irion O, Boulvain M. Maternal positioning to correct occipito-posterior fetal position in labour: a randomised controlled trial. *BMC Pregnancy and Childbirth* 2014;**14**(1):83. [CENTRAL: CN-01118251] [EMBASE: 53026418] [PMID: 24564746]

NCT01291355. Maternal positioning and occipitoposterior fetal position. clinicaltrials.gov/show/NCT01291355 (first received 7 February 2011). [CENTRAL: CN-02026525]

Suzuki S. Re: maternal positioning to correct occiput posterior fetal position during the first stage of the labour: a randomised controlled trial. *BJOG: an international journal of obstetrics and gynaecology* 2017;**124**(7):1123-4. [EMBASE: 616364611]

Le Ray 2016 *{published data only}*

Blanc-Petitjean P, Le Ray C, Lepleux F, De La Calle A, Dreyfus M, Chantry AA. Factors affecting rotation of occiput posterior position during the first stage of labor. *Journal of Gynecology Obstetrics and Human Reproduction* 2018;**47**(3):119-25. [CENTRAL: CN-01627539] [PMID: 29294363]

Le Ray C, Lepleux F, De La Calle A, Guerin J, Sellam N, Dreyfus M, et al. Lateral asymmetric decubitus for rotation of occiput posterior position: multicenter randomized controlled trial EVADELA. *American Journal of Obstetrics and Gynecology* 2016b;**214**(1 Suppl):S335-S336. [CENTRAL: CN-01134796] [EMBASE: 72164820]

* Le Ray C, Lepleux F, De La Calle A, Guerin J, Sellam N, Dreyfus M, et al. Lateral asymmetric decubitus position for the rotation of occipito-posterior positions: multicenter randomized controlled trial EVADELA. *American Journal of Obstetrics and Gynecology* 2016;**215**(4):511.e1-7. [CENTRAL: CN-01368865] [PMID: 27242201]

NCT01854450. Evaluation of asymmetrical lateral decubitus for rotation of occipitoposterior fetal position [Evaluation of asymmetrical lateral decubitus for rotation of occipitoposterior fetal position during labor: EVADELA multicentre randomized trial]. clinicaltrials.gov/show/NCT01854450 (first received 13 May 2013). [CENTRAL: CN-01542175]

Liu 2018 *{published data only}*

Liu L-P, Chen J-H, Yang Z-J, Zhu J. Corrective effects of maternal extreme flexure and hip abduction combined with contralateral side-lying on persistent foetal occipito-posterior position. *International Journal of Nursing Practice* 2018;**24**(5):e12663. [CENTRAL: CN-01651307]

Molina-Reyes 2014 *{published data only}*

Molina Reyes C, Munoz Martinez AL, Herrera Cabrerizo B, Berral Gutierrez MA, Moore T, Alcantara Lopez C. Investigation project: the efficacy of the intervention of maternal position during labor to change a persistent occipitoposterior fetal position. *Journal of Maternal-fetal & Neonatal Medicine* 2010;**23**(S1):279-80. [CENTRAL: CN-00794281]

Molina Reyes CY, Berral Gutierrez A, Huete Morales D, Martinez Garcia E, Castellano Ibanez FD. Maternal satisfaction in the clinical trial 'the efficacy of maternal posturing during labor on the prevention of fetal occiput posterior position' [Satisfacción materna en el ensayo clínico "Eficacia de la postura materna en partos con malj fetal occipitoposterior"]. *Metas de Enfermeria* 2013;**16**(9):60-7.

Molina-Reyes CY, Martinez-Garcia E, Huete-Morales MD, Munoz-Martinez AL, Maldonado-Molina E, Molina-Cubero L. Maternal comfort and pain reduction for women in labour with fetal occiput-posterior position by using lateral decubitus and hands and knees postures: a randomised clinical trial [Comodidad materna y reduccion del dolor en mujeres con posicion fetal occipitoposterior durante el parto con el uso de las posturas de decubito lateral y manos-rodillas: ensayo clinico aleatorizado]. *Matronas Profesion* 2013;**14**(1):3-9. [CENTRAL: CN-02135242]

* Molina-Reyes CY, Muñoz-Martínez AL, Martínez-García E, Moore TL, Huete-Morales MD, Burgos-Sánchez JA. Eficacia de la postura materna manos-rodillas para corregir la posición fetal occipitoposterior en el parto. *Index de Enfermería* 2014;**23**(1/2):15-20.

Stremler 2005 *{published and unpublished data}*

* Stremler R, Hodnett E, Petryshen P, Stevens B, Weston J, Willan AR. Randomized controlled trial of hands-and-knees positioning for occipitoposterior position in labor. *Birth (Berkeley, Calif.)* 2005;**32**(4):243-51. [CENTRAL: CN-00553411] [PMID: 16336365]

Stremler R. The Labour Position Trial: A Randomized, Controlled Trial of Hands and Knees Positioning for Women Labouring with a Fetus in Occipitoposterior Position [Thesis]. Toronto (Canada): University of Toronto, 2003.

References to studies excluded from this review

Andrews 1981 *{published data only}*

Andrews CM. Nursing intervention to change a malpositioned fetus. *Advances in Nursing Science* 1981;**3**:53-66. [CENTRAL: CN-00230276]

Kariminia 2004 *{published data only}*

* Kariminia A, Chamberlain ME, Keogh J, Shea A. Randomised controlled trial of effect of hands and knees posturing on incidence of occiput posterior position at birth. *BMJ* 2004;**328**(7438):490.

Kariminia A, Keogh J, Chamberlain M. The effect of hands and knees exercise on the incidence of OP position at birth. In: Perinatal Society of Australia and New Zealand 7th Annual Congress; 2003 March 9-12; Tasmania, Australia. 2003. [CENTRAL: CN-00433437]

Zhang 2017 *{published data only}*

Zhang H, Huang S, Guo X, Zhao N, Lu Y, Chen M, et al. A randomised controlled trial in comparing maternal and neonatal outcomes between hands-and-knees delivery position and supine position in China. *Midwifery* 2017;**50**:117-24. [CENTRAL: CN-01600517] [EMBASE: 621962182] [PMID: 28414983]

References to studies awaiting assessment

Lu 2001 *{published data only}*

Lu JX, Li HX, Shu BL. Clinical observation of lateral-prostrate position preventing persistent OP/OT position. *Journal of Nursing Science* 2001;**16**(3):136-7. [CENTRAL: CN-00601229]

Ou 1997 *{published data only}*

Ou X, Chen X, Su J. Correction of occipito-posterior position by maternal posture during the process of labor. *Zhonghua Fu Chan Ke za Zhi [Chinese Journal of Obstetrics and Gynecology]* 1997;**32**(6):329-32. [CENTRAL: CN-00150937] [PMID: 9596909]

Wu 2001 *{published data only}*

Wu X, Fan L, Wang Q. Correction of occipito-posterior by maternal postures during the process of labor. *Zhonghua Fu Chan Ke za Zhi [Chinese Journal of Obstetrics and Gynecology]* 2001;**36**(8):468-9. [CENTRAL: CN-00406800] [PMID: 11758180]

Additional references

Aiken 2015

Aiken AR, Aiken CE, Albery MS, Brocklesby JC, Scott JG. Management of fetal malposition in the second stage of labour: a propensity score analysis. *American Journal of Obstetrics and Gynecology* 2015;**212**(3):355 e1-7. [DOI: 10.1016/j.ajog.2014.10.023]

Akmal 2003

Akmal S, Kametas N, Tsoi E, Hargreaves C, Nicolaides KH. Comparison of transvaginal digital examination with intrapartum sonography to determine fetal head position before instrumental delivery. *Ultrasound in Obstetrics and Gynecology* 2003;**21**(5):437-40. [DOI: 10.1002/uog.103]

Akmal 2004

Akmal S, Tsoi E, Howard R, Osei E, Nicolaides KH. Investigation of occiput posterior delivery by intrapartum sonography. *Ultrasound in Obstetrics and Gynecology* 2004;**24**(4):425-8. [DOI: 10.1111/j.1471-0528.2004.00134.x]

Allman 1996

Allman AC, Genevier ES, Johnson MR, Steer PJ. Head-to-cervix force: an important physiological variable in labour. 2. Peak active force, peak active pressure and mode of delivery. *British Journal of Obstetrics and Gynaecology* 1996;**103**(8):769-75. [DOI: 10.1111/j.1471-0528.1996.tb09871.x]

Anderson 1965

Anderson DG. Arrested occiput posterior positions. *Clinical Obstetrics and Gynecology* 1965;**8**(4):867-81. [DOI: 10.1097/00003081-196512000-00006]

Andrews 2004

Andrews CM, Andrews EC. Physical theory as a basis for successful rotation of fetal malpositions and conversion of fetal malpresentations. *Biological Research for Nursing* 2004;**6**(2):126-40. [DOI: 10.1177/1099800404268318]

Ashwal 2016

Ashwal E, Wertheimer A, Aviram A, Pauzner H, Wiznitzer A, Yogev Y, et al. The association between fetal head position prior to vacuum extraction and pregnancy outcome. *Archives of Gynecology and Obstetrics* 2016;**293**(3):567-73. [DOI: 10.1007/s00404-015-3884-x]

Ayers 2001

Ayers S, Pickering AD. Do women get post-traumatic stress disorder as a result of childbirth? A prospective study of incidence. *Birth* 2001;**28**:111-8. [DOI: 10.1097/01.grf.0000129919.00756.9c]

Barbier 2007

Barbier A, Poujade O, Fay R, Thiebaugeorges O, Levardon M, Deval B. Is primiparity, the only risk factor for type 3 and 4 perineal injury, during delivery? *Gynecologie, Obstetrique and Fertilite* 2007;**35**(2):101-6. [DOI: 10.1016/j.gyobfe.2006.12.017]

Barth 2015

Barth WH. Persistent occiput posterior. *Obstetrics and Gynecology* 2015;**125**(3):695-709. [DOI: 10.1097/AOG.0000000000000647]

Blumenthal 1982

Blumenthal NJ, Merrell DA, Langer O. Obstetrics in the very young black South African teenager. *South African Medical Journal* 1982;**61**(14):518-20. [www.ncbi.nlm.nih.gov/pubmed/7064033]

Boog 2006

Boog G. How to reduce the incidence and complications of occiput posterior positions during delivery? *Gynecologie, Obstetrique and Fertilite* 2006;**34**(11):1003-6. [DOI: 10.1016/j.gyobfe.2006.09.007]

Carlisle 2017

Carlisle JB. Data fabrication and other reasons for non-random sampling in 5087 randomised, controlled trials in anaesthetic and general medical journals. *Anaesthesia* 2017;**72**(8):944-52. [DOI: https://doi.org/10.1111/anae.13938]

Cheng 2006a

Cheng YW, Shaffer BL, Caughey AB. Associated factors and outcomes of persistent occiput posterior position: a retrospective cohort study from 1976 to 2001. *Journal of Maternal-fetal & Neonatal Medicine* 2006;**19**(6):563-8. [DOI: 10.1080/14767050600682487]

Cheng 2006b

Cheng YW, Shaffer BL, Caughey AB. The association between persistent occiput posterior position and neonatal outcomes. *Obstetrics and Gynecology* 2006;**107**(4):837-44. [DOI: 10.1097/01.AOG.0000206217.07883.a2]

Cheng 2006c

Cheng YW, Norwitz ER, Caughey AB. The relationship of fetal position and ethnicity with shoulder dystocia and birth injury. *American Journal of Obstetrics & Gynecology* 2006;**195**(3):856-62. [PMID: 10.1016/j.ajog.2006.06.017]

Cunningham 2018

Cunningham FG, Leveno KJ, Bloom SL, Dashe JS, Hoffman BL, Casey BM, et al. Williams Obstetrics. 25th edition. New York: McGraw-Hill Education, 2018.

de la Torre 2006

de la Torre L, Gonzalez-Quintero VH, Mayor-Lynn K, Smarkusky L, Hoffman MC, Saab A, et al. Significance of accidental extensions in the lower uterine segment during cesarean delivery. *American Journal of Obstetrics and Gynecology* 2006;**194**(5):4-6. [DOI: 10.1016/j.ajog.2006.01.026]

Doggett 1967

Doggett TH. Management of the persistent occiput posterior position. *Southern Medical Journal* 1967;**60**(5):494-7. [DOI: 10.1097/00007611-196705000-00011]

Dudding 2008

Dudding TC, Vaizey CJ, Kamm MA. Obstetric anal sphincter injury: incidence, risk factors, and management. *Annals of Surgery* 2008;**247**(2):224-37. [DOI: 10.1097/SLA.0b013e318142cdf4]

Eggebo 2015

Eggebo TM, Hassan WA, Salvesen KA, Torkildsen EA, Ostborg TB, Lees CC. Prediction of delivery mode by ultrasound-assessed fetal position in nulliparous women with prolonged first stage of labor. *Ultrasound in Obstetrics and Gynecology* 2015;**46**(5):606-10. [DOI: 10.1002/uog.14773]

El-Mowafi 2017

El-Mowafi DM. Maternal changes due to pregnancy. In: Campana A, editors(s). Obstetrics Simplified. Geneva: GMFR Geneva Foundation For Medical Education and Research, 2017.

Fitzpatrick 2001

Fitzpatrick M, McQuillan K, O'Herlihy C. Influence of persistent occiput posterior position on delivery outcome. *Obstetrics and Gynecology* 2001;**98**(6):1027-31. [DOI: 10.1016/s0029-7844(01)01600-3]

Gardberg 1994

Gardberg M, Tuppurainen M. Anterior placental location predisposes for occiput posterior presentation near term. *Acta Obstetricia et Gynecologica Scandinavica* 1994;**73**(2):151-2. [DOI: 10.3109/00016349409013418]

Gardberg 1998

Gardberg M, Laakkonen E, Salevaara M. Intrapartum sonography and persistent occiput posterior position: a study of 408 deliveries. *Obstetrics and Gynecology* 1998;**91**(5 Pt 1):746-9. [DOI: 10.1016/s0029-7844(98)00074-x]

Ghi 2016

Ghi T, Youssef A, Martelli F, Bellussi F, Aiello E, Pilu G, et al. Narrow subpubic arch angle is associated with higher risk of persistent occiput posterior position at delivery. *Ultrasound in Obstetrics and Gynecology* 2016;**48**(4):511-5. [DOI: 10.1002/uog.15808]

Gilboa 2013

Gilboa Y, Kivilevitch Z, Spira M, Kedem A, Katorza E, Moran O, et al. Pubic arch angle in prolonged second stage of labor: clinical significance. *Ultrasound in Obstetrics and Gynecology* 2013;**41**(4):442-6. [DOI: 10.1002/uog.12304]

GRADEpro GDT [Computer program]

McMaster University (developed by Evidence Prime) GRADEpro GDT. Version accessed 1 December 2021. Hamilton (ON): McMaster University (developed by Evidence Prime). Available at gradepro.org.

Higgins 2011

Higgins JP, Green S, editor(s. Cochrane Handbook for Systematic Reviews of InterventionsVersion 5.1.0 (updated March 2011). The CochraneCollaboration, 2011. Available from training.cochrane.org/handbook/archive/v5.1/.

Higgins 2021

Higgins JP, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, et al (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 6.2 (updated February 2021). Cochrane 2021. Available from www.training.cochrane.org/handbook 2021.

Higgins 2022

Higgins JPT, Eldridge S, Li T (editors) . Chapter 23: Including variants on randomized trials. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022). Cochrane, 2022 . Available from www.training.cochrane.org/handbook.

Hodnett 1987

Hodnett ED, Simmons-Tropea DA. The Labour Agentry Scale: psychometric properties of an instrument measuring control during childbirth. *Research in Nursing and Health* 1987;**10**(5):301-10. [DOI: 10.1002/nur.4770100503]

Hodnett 2013

Hodnett ED, Stremler R, Halpern SH, Weston J, Windrim R. Repeated hands-and-knees positioning during labour: a randomized pilot study. *PeerJ* 2013;**1**:e25. [DOI: 10.7717/peerj.25] [PMID: PMC3629039]

Ingemarsson 1980

Ingemarsson E, Ingemarsson I, Solum T, Westgren M. Influence of occiput posterior position on the fetal heart rate pattern. *Obstetrics and Gynecology* 1980;**55**(3):301-4. [DOI: 10.1097/00006250-198003000-00006]

Kjaergaard 2008

Kjaergaard H, Olsen J, Ottesen B, Nyberg P, Dykes AK. Obstetric risk indicators for labour dystocia in nulliparous women: a multi-centre cohort study. *BMC Pregnancy and Childbirth* 2008;**8**(1):45. [DOI: 10.1186/1471-2393-8-45]

Kutcipal 1959

Kutcipal RA. The persistent occiput posterior position: a review of 498 cases. *Obstetrics and Gynecology* 1959;**14**:296-304. [www.ncbi.nlm.nih.gov/pubmed/14412967]

Lee 2021

Lee N, Munro V, Oliver K, Flynn J. Maternal positioning with flexed thighs to correct foetal occipito-posterior position in labour: a systematic review and meta-analysis. *Midwifery* 2021;**99**:103008. [DOI: 10.1016/j.midw.2021.103008]

Levy 2021

Levy AT, Weingarten S, Ali A, Quist-Nelson J, Berghella V. Hands-and-knees posturing and fetal occiput anterior position: a systematic review and meta-analysis. *American Journal of Obstetrics & Gynecology MFM* 2021;**3**(4):100346. [DOI: 10.1016/j.ajogmf.2021.100346]

Lieberman 2005

Lieberman E, Davidson K, Lee-Parritz A, Shearer E. Changes in fetal position during labor and their association with epidural analgesia. *Obstetrics and Gynecology* 2005;**105**(5 Pt 1):974-82. [DOI: 10.1097/01.AOG.0000158861.43593.49]

Liljestrom 2018

Liljestrom L, Wikstrom AK, Agren J, Jonsson M. Antepartum risk factors for moderate to severe neonatal hypoxic ischemic encephalopathy: a Swedish national cohort study. *Acta Obstetricia et Gynecologica Scandinavica* 2018;**97**(5):615-23. [DOI: 10.1111/aogs.13316]

Lydon-Rochelle 2001

Lydon-Rochelle MT, Holt VL, Martin DP. Delivery method and self-reported postpartum general health status among primiparous women. *Journal of Paediatric Perinatal Epidemiology* 2001;**15**(3):232-40. [ISSN 0269-5022]

Martins 2011

Martins VB, Toledo Florêncio TM, Grillo LP, do Carmo P, Franco M, Martins PA, et al. Long-lasting effects of undernutrition. *International Journal of Environmental Research and Public Health* 2011;**8**(6):1817-46. [DOI: 10.3390/ijerph8061817] [PMID: PMC3137999]

Menichini 2021

Menichini D, Mazzaro N, Minniti S, Ricchi A, Molinazzi MT, Facchinetti F, et al. Fetal head malposition and epidural analgesia in labor: a case-control study. Journal of Maternal-Fetal & Neonatal Medicine 2021 Feb 21 [online publication]:1-10. [DOI: 10.1080/14767058.2021.1890018]

Orlovic 2017

Orlovic M, Carter AW, Marti J, Mossialos E. Estimating the incidence and the economic burden of third and fourth-degree obstetric tears in the English NHS: an observational study using propensity score matching. *BMJ Open* 2017;**7**(6):e015463. [DOI: 10.1136/bmjopen-2016-015463]

Parente 2009

Parente MP, Jorge RM, Mascarenhas T, Fernandes AA, Martins JA. The influence of an occipito-posterior malposition on the biomechanical behavior of the pelvic floor. *European Journal of Obstetrics, Gynecology, and Reproductive Biology* 2009;**144**(Suppl 1):166-9. [DOI: 10.1016/j.ejogrb.2009.02.033]

Phipps 2014

Phipps H, Hyett JA, Graham K, Carseldine WJ, Tooher J, de Vries B. Is there an association between sonographically determined occipito-transverse position in the second stage of labor and operative delivery? *Acta Obstetricia et Gynecologica Scandinavica* 2014;**93**(10):1018-24. [DOI: 10.1111/birt.12094]

Ponkey 2003

Ponkey SE, Cohen AP, Heffner LJ, Lieberman E. Persistent fetal occiput posterior position: obstetric outcomes. *Obstetrics and Gynecology* 2003;**101**(5 Pt 1):915-20. [DOI: 10.1016/s0029-7844(03)00068-1]

Randal 1952

Randal JH. The persistent occiput posterior. *Journal of Iowa State Medical Society* 1952;**42**:148-51. [www.ncbi.nlm.nih.gov/pubmed/14917902]

Review Manager 2014 [Computer program]

The Nordic Cochrane Centre, The Cochrane Collaboration Review Manager 5 (RevMan 5). Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.

Robinson 1996

Robinson CA, Macones GA, Roth NW, Morgan MA. Does station of the fetal head at epidural placement affect the position of the fetal vertex at delivery? *American Journal of Obstetrics and Gynecology* 1996;**175**(4):991-4. [DOI: 10.1016/S0002-9378(96)80039-1]

Schünemann 2013

Schünemann H, Brożek J, Guyatt G, Oxman A, editor(s). Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach (updated October 2013). GRADE Working Group, 2013. Available from gdt.guidelinedevelopment.org/app/handbook/handbook.html.

Senécal 2005

Senécal J, Xiong X, Fraser WD. Effect of fetal position on second-stage duration and labour outcome. *Obstetrics and Gynecology* 2005;**105**(4):763-72. [DOI: 10.1097/01.AOG.0000154889.47063.84]

Sherer 2002

Sherer DM, Miodovnik M, Bradley KS, Langer O. Intrapartum fetal head position I: comparison between transvaginal digital examination and transabdominal ultrasound assessment during the active stage of labor. *Ultrasound in Obstetrics and Gynecology* 2002;**19**(3):258-63. [DOI: 10.1046/j.1469-0705.2002.00641.x]

Sokol 1981

Sokol RJ. Occiput posterior position and fetal heart rate patterns. *Obstetrics and Gynecology* 1981;**57**(2):266-7.

Souka 2003

Souka AP, Haritos T, Basayiannis K, Noikokyri N, Antsaklis A. Intrapartum ultrasound for the examination of the fetal head position in normal and obstructed labor. *Journal of Maternal-fetal & Neonatal Medicine* 2003;**13**(1):59-63. [DOI: 10.1080/jmf.13.1.59.63]

Stremler 2003

Stremler RL. The Labour Position Trial: A Randomized, Controlled Trial of Hands and Knees Positioning for Women Labouring with a Fetus in Occipitoposterior Position [Thesis]. Toronto (Canada): University of Toronto, 2003. [search.ebscohost.com/login.aspx?direct=true&db=jlh&AN=109843601&site=ehost-live]

Suonio 1986

Suonio S, Saarikoski S, Raty E, Vohlonen I. Clinical assessment of the pelvic cavity and outlet. *Archives of Gynecology* 1986;**239**(1):11-6. [DOI: 10.1007/bf02134282]

Sutton 2000

Sutton J. Occiput-posterior positioning and some ideas about how to change it! *Practising Midwife* 2000;**3**(6):20-2. [ISSN: 1461-3123]

Wijma 1997

Wijma K, Soderquist J, Wijma B. Posttraumatic stress disorder after childbirth: a cross sectional study. *Journal of Anxiety Disorders* 1997;**11**:587-97. [DOI: 10.1016/s0887-6185(97)00041-8]

World Health Organization 1996

World Health Organization (WHO). Care in normal birth: a practical guide; 1996. Report of a Technical Working Group. Report No.: WHO/FRH/MSM/96.24. Available at: cdn1.sph.harvard.edu/wp-content/uploads/sites/2413/2014/08/WHO_FRH_MSM_96.24.pdf (accessed prior to 27 July 2022). [WHO/FRH/MSM/96.24]

Zahalka 2005

Zahalka N, Sadan O, Malinger G, Liberati M, Boaz M, Glezerman M, et al. Comparison of transvaginal sonography with digital examination and transabdominal sonography for the determination of fetal head position in second stage of labour. *American Journal of Obstetrics and Gynecology* 2005;**193**(2):381-6. [DOI: 10.1016/j.ajog.2004.12.011]

References to other published versions of this review

Barrowclough 2019

Barrowclough J, Kool B, Hofmeyr GJ, Crowther C . Maternal postures for fetal malposition in labour for improving the health of mothers and their infants. PROSPERO 2021 CRD42021214341 Available from: www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021214341.

Hunter 2007

Hunter S, Hofmeyr GJ, Kulier R. Hands and knees posture in late pregnancy or labour for fetal malposition (lateral or posterior). *Cochrane Database of Systematic Reviews* 2007, Issue 4. Art. No: CD001063. [DOI: 10.1002/14651858.CD001063.pub3]

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Bahmaei 2018

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 180 **Setting:** Ramhormoz maternity ward, Ahvaz, Iran **Study dates**: April to August 2017 **Inclusion criteria**: primiparous, gestational age ≥ 37 weeks, singleton pregnancy, maternal age between 18 and 40 years, BMI between 18 to 30 kg/m^2, in the active phase of labour (dilatation ≥ 4 cm), and occipital-posterior fetal position assessed by vaginal examination and confirmed by vaginal sonogram. **Exclusion criteria:** preterm labour, an indication for induction of labour, severe vaginal bleeding, and situations when the mother was not allowed active movement during labour.
Interventions	**Experimental intervention:** Posture 1) semi-prone (similar to lateral position, except that the anterior body weight is on the shoulder and hip) with lower arm located toward the back of the body and other arm flexed at shoulder and elbow. Upper leg is hyper flexed in hip and knee joints and aligned with waist line. Bottom leg is slightly flexed in hip and knee joints. A pillow is placed under upper arm and leg, and under participant's head. n = 45 Posture 2) prostration (described as knees to chest – "similar to hands and knees"). Participant's chest is on the bed, hips higher than chest, and hips rock side to side. n = 45 Postures maintained for at least 15 to 30 minutes every hour. Total number randomised: n = 90 **Control/comparison intervention:** supine or lateral position maintained throughout labour Total number randomised: n = 90
Outcomes	**Outcomes:** duration of active phase (time frame from 4 cm to 10 cm cervical dilatation) and second stage of labour (time frame from 10 cm to birth); labour pain intensity at 4, 6, 8, 10 cm dilatation and in second stage; type of delivery; newborn Apgar score at 1 minute and 5 minutes; frequency of use of oxytocin during first and second stage labour; maternal satisfaction with delivery (Iranian adapted version of the Mackey satisfaction scale); frequency of episiotomy; frequency of third- and fourth-degree perineal lacerations; fetal head position at birth.
Notes	**Funding:** Vice-chancellor of Research, Jundishapur University of Medical Sciences, Iran **Declarations of interest:** not reported This paper only reports 2 of the 10 outcomes that were assessed in the trial (as listed on the registered clinical trial protocol). The protocol states that the study objective was to "evaluate the efficacy of maternal position in labour to correct occipito-posterior fetal position and delivery outcome". However, the English abstract of the published paper states, "This study aimed to investigate the effect of maternal position in the active phase of labor on the pain intensity and satisfaction". Pain score at 4 cm was prior to the intervention

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

Bahmaei 2018 *(Continued)*

Random sequence generation (selection bias)	Low risk	"Randomised to different groups by a randomiser software".
Allocation concealment (selection bias)	Unclear risk	No details provided on whose responsibility it was to access the software, when they accessed it, and whether before another participant.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Not blinded. Not possible to blind participants or personnel given the labour care within study group allocations.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"After labour, participants were asked about their satisfaction with their labour position (very dissatisfied, dissatisfied, neutral, satisfied, and very satisfied)". However, for outcome pain, it was not clear whether participant or staff completed visual analogue score for pain, which was during intervention.
Incomplete outcome data (attrition bias) All outcomes	Low risk	11 lost to follow-up (2 in trial group 1; 3 in trial group 2; 4 in control group) as left the study. However < 10% for each group not likely to affect result for satisfaction.
Selective reporting (reporting bias)	High risk	Only 2 out of 10 outcomes listed in the registration protocol were reported (labour pain intensity and mother satisfaction). No reporting of main maternal outcome related to objective of study (correction of occipito-posterior head position). No other publications of outcomes were located.
Other bias	Unclear risk	Not clear whether intention-to-treat analysis for pain intensity as totals not provided. No evidence of other bias.

Bueno-Lopez 2018

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 120 **Setting:** Level 3 hospital, Barcelona, Spain **Study dates:** March 2014 to October 2016 **Inclusion criteria:** adult pregnant women > 18 years of age, persistent occipito-posterior fetal position diagnosed during the active phase of labour through 2 vaginal exams 2 hours apart and confirmed by transabdominal ultrasound prior to randomisation; at term gestations (37 to 42 weeks); women in labour with epidural anaesthesia. **Exclusion criteria:** multiple gestations; previous severe fetal abnormality diagnosed; macrosomic fetus diagnosed by ultrasound in the 3rd trimester (> 95th percentile) or intrauterine growth restriction (IUGR; < 10th percentile); women with contraindicated vaginal delivery owing to previous vaginal surgeries; women with severe heart diseases; diabetic pregnant women (types I, II and gestational); hypertension problems during labour; morbid maternal obesity (BMI > 40 kg/m^2) and myopathies.
Interventions	**Experimental intervention:** modified Sims position: lateral decubitus on same side as fetus, upper leg bent 90° on stirrup with slight interior rotation. Lower leg outstretched. Posture maintained for at least 40 mins every hour, and until either fetal rotation or the delivery took place. Total number randomised: n = 60

Bueno-Lopez 2018 *(Continued)*

	Control/comparison intervention: free position. Can only use lateral postures for up to 20 mins each hour. The intervention continued until either fetal rotation or delivery took place. Total number randomised: n = 60
Outcomes	Anterior rotation of fetal occiput yes/no, manual rotation 2 hours after full dilatation if persistent occiput posterior (POP), total rotation (spontaneous and manual rotation), type of delivery (spontaneous, instrumental, caesarean) and vaginal (spontaneous or instrumental vaginal), postpartum perineal condition (episiotomy, lacerations grade 1, 2, 3, 4, or intact), comfort and level of satisfaction. Neonatal outcomes: Apgar score at birth, at 5 minutes, and 10 minutes, and cord pH.
Notes	**Funding:** University Hospital Val d'Hebron Research Institute, Barcelona **Declarations of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"After inclusion, they were randomly assigned to the intervention or the control group, using a computer-generated sequence."
Allocation concealment (selection bias)	Unclear risk	No information provided on who accessed the computer or when, e.g. consecutively after each participant.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes Open trial. Not possible to blind participants or personnel given the labour care within study group allocations.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome group: all outcomes Single masking of outcomes assessor. Outcomes comfort and satisfaction during labour were assessed after labour.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome group: all outcomes "1 participant was removed from the study after the information was lost." (< 10%)
Selective reporting (reporting bias)	High risk	All outcomes in methods are reported. However, text does not report on duration of first/second stage and epidural (in protocol), and includes Apgar score and cord pH.
Other bias	Low risk	No other forms of bias detected. Conflict of interest not mentioned. Intention-to-treat analysis except for 1 participant who was removed when information was lost.

Desbriere 2013

Study characteristics

Methods	RCT
Participants	**Number of women randomised:** 220 **Setting:** a tertiary care centre maternity unit - Hôpital Nord, Marseille, France

Desbriere 2013 *(Continued)*

	Study dates: 5 January 2009 to 25 January 2011 **Inclusion criteria:** those eligible had provided written, informed consent prior to randomisation and were adult pregnant women (age ≥ 18 years) in labour at ≥ 36 weeks of gestation, with cervical dilatation of ≥ 3 cm and ruptured membranes, and with a single fetus in cephalic OP position confirmed by ultrasound examination. Gestational age calculation was based on the participant's reported last menstrual period and fetal biometry at first-trimester systematic ultrasound scan. **Exclusion criteria:** nil given
Interventions	**Experimental intervention:** a sequence of postures was adopted depending on the station of the fetal head: posture 1 used the hands and knees posture when fetal head station between -5 and -3; posture 2 used a strict lateral recumbent position on the same side of the fetal spine with folded inferior leg and upper leg positioned in the axis of the body when fetal head station between -2 and 0; posture 3 used a lateral recumbent position on the same side of the fetal spine, with the inferior leg lying in the axis of the body and the other leg folded at an approximately 90-degree angle with the use of a leg support when fetal head station > 0. Women who achieved anterior rotation were then asked to adopt the dorsal recumbent position. Total number randomised: n = 110 **Control/comparison intervention:** dorsal recumbent position. Total number randomised: n = 110
Outcomes	**Primary:** fetal head position at spontaneous vaginal delivery, or immediately before operative vaginal delivery or caesarean section **Secondary:** length of labour, length of pushing, operative deliveries, caesarean sections, perineal lacerations (Anglo-Saxon classification), oxytocin use, neonatal morbidity (Apgar score at 5 minutes, Apgar score at 10 minutes, umbilical arterial pH) and neonatal intensive care unit stay.
Notes	**Funding:** not reported **Declarations of interest:** none

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The randomisation was made in permutated blocks of 4; however, no details are provided on the source of the random sequence.
Allocation concealment (selection bias)	Unclear risk	After inclusion, participants were randomly assigned to the intervention or control group. No details provided on who accessed the random sequence and allocated the participants.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes Not possible to blind participants or personnel given the labour care within study group allocations.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome group: all outcomes For all participants who achieved vaginal spontaneous delivery, the midwife or the obstetrician in charge of the delivery systematically recorded the exact type of fetal head presentation observed at the time of vaginal delivery. In cases of operative delivery, the fetal head position was recorded by means of ultrasonography immediately before the instruments (either forceps or vacuum) were applied. If a caesarean delivery was performed, the fetal head presentation was confirmed by ultrasonography immediately before caesarean section. Unclear if these assessments were influenced by knowledge of the treatment group allocation.

Desbriere 2013 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome group: all outcomes Intention-to-treat analysis.
Selective reporting (reporting bias)	Low risk	All outcomes in study methods reported
Other bias	Low risk	No other sources of bias identified. Intention-to-treat analysis. No protocol deviations in the intervention group. Authors report no conflict of interest.

Guittier 2016

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 439 **Setting:** Geneva University Hospitals, Switzerland. The unit was the largest in Switzerland with 4000 births/year. **Study dates:** March 2011 to December 2013 **Inclusion criteria:** nulliparous and multiparous women, aged 18 to 48 years, in the first stage of labour (cervix dilated 2 cm to 9 cm), singleton, term ≥ 37 weeks' gestation, diagnosis of occipito-posterior fetus confirmed by ultrasound. **Exclusion criteria:** maternal age below 18 years, limited understanding of French language, full dilatation of the cervix, previous use of evaluated posture during the 1st stage of labour.
Interventions	**Experimental intervention:** women allocated to the intervention group were invited to adopt a type of hands and knees posture: "support on the knees, torso tilted forward, back stretched" for a minimum of 10 minutes. A cushion was placed between the legs of the woman in labour to limit discomfort. After 10 minutes, women could remain in the posture or change positions if they preferred. Total number randomised: n = 220. **Control/comparison intervention:** women in the control group had no specific intervention other than usual care. Immediately after randomisation, they continued use of their pre-randomisation posture (e.g. sitting or standing or semi-recumbent or lateral) for at least 1 hour (not hands and knees). After 1 hour, they were given the option to adopt the hands and knees posture if they wished to do so. Total number randomised: n = 219.
Outcomes	**Primary:** fetal head position after the intervention compared to the control group (time frame: 1 hour after randomisation or at delivery if came first). **Secondary:** maternal comfort and pain sensation (time frame: 15 minutes after randomisation) by evaluation of the comfort of maternal posture; impact of maternal posture on perceived pain; duration of first and second stage of labour; mode of delivery; perineal status; and markers of neonatal asphyxia (Apgar score < 7 at 5 mins, umbilical artery pH, and neonatal resuscitation).
Notes	**Funding:** Swiss National Science Foundation (SNFS, DORE research grants) and the ReSAR. **Declarations of interest:** none

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

Guittier 2016 *(Continued)*

Random sequence generation (selection bias)	Low risk	Web-based system provided by the informatics department of the Geneva University Hospitals. Randomisation was performed using randomly permutated blocks of varying sizes (4, 6, and 8) stratified by parity (nulliparous/multiparous) and epidural analgesia (yes/no). The ratio for hands and knees versus expectant management was 1:1.
Allocation concealment (selection bias)	Low risk	After confirming eligibility and consent, the randomisation system returned the allocation of the woman to the midwife.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes Not possible to blind participants or personnel given the labour care within study group allocations.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome group: all outcomes Fetal head position assessed by ultrasound after 1 hour by staff attending labour.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcomes group: all outcomes All randomised participants were included in the analysis.
Selective reporting (reporting bias)	Low risk	All outcomes in methods reported.
Other bias	Low risk	No evidence of other sources of bias. Intention-to-treat analyses. Sample size given.

Le Ray 2016

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 322 **Setting:** 4 French maternity units. Two level 3 university hospital maternity units (Port Royal, Paris & Caen University Hospital, Normandy), a level 2 maternity unit (Avranches-Granville, Normandy) and a level 1 maternity unit (Les Bluets, Paris) **Study dates:** May 2013 to December 2014 **Inclusion criteria:** ≥ 18 years of age, in labour with ruptured membranes, singleton term fetus (37 weeks of gestation) in an OP position clinically diagnosed between 2 cm and 9 cm of cervical dilation and confirmed by transabdominal ultrasound imaging just above the symphysis, demonstrating the position of the fetal orbits, the falx, and the fetal spine. **Exclusion criteria:** women with complications during pregnancy, small-for-gestational-age fetuses, in utero fetal deaths, those who did not understand French, or women who used the lateral asymmetric decubitus (LAD) posture before inclusion and randomisation.
Interventions	**Experimental intervention:** women were positioned in the LAD posture for 1 hour after randomisation and a minimum of 30 mins. LAD was a pronounced lateral recumbent posture, lying on the side opposite the fetal spine with the inferior leg positioned in the axis of the body and the upper leg hyperflexed (spine-femur angle, < 90 degrees) with the shin propped up on a stirrup. After the first hour after randomisation, women were asked to maintain the posture for as long as possible during first stage of labour. After first stage was complete, midwives and obstetricians could recommend other maternal

Le Ray 2016 *(Continued)*

	postures or attempt manual rotation performed according to unit's regular practice. Total number randomised: n = 160 (15 women wrongly enrolled, i.e. did not meet eligibility criteria, so not randomised). **Control/comparison intervention:** women used the dorsal recumbent posture for the first hour after randomisation and were then encouraged to maintain it for as long as possible during labour. Later in labour, women could use any position except LAD, if they wanted to or if they needed to due to fetal heart rate abnormalities. After first stage was complete, midwives and obstetricians could recommend other maternal postures or attempt manual rotation according to unit's regular practice. Total number randomised: n = 162 (15 women wrongly enrolled i.e., did not meet eligibility criteria, so not randomised).
Outcomes	**Outcomes:** **Maternal:** occipito-anterior (OA) fetal position 1 hour after randomisation or at birth if this was sooner, OA position at full cervical dilatation and at delivery, speed of cervical dilatation during labour, duration of expulsive efforts, mode of delivery (spontaneous, instrumental, or caesarean), perineal laceration (episiotomy, third or fourth degree lacerations), hyperthermia (temperature ≥ 38°), postpartum haemorrhage (PPH) (≥ 500 mL), severe PPH (> 1000 mL or need for treatment to stop haemorrhage), maternal satisfaction about the comfort of the posture (very comfortable/comfortable/not really comfortable/uncomfortable), and pain intensity at 1 hour after randomisation (using the visual analogue scale). **Neonatal:** umbilical arterial pH at birth, Apgar score at 5 and 10 minutes, resuscitation (ventilation or intubation), transfer to neonatal intensive care unit
Notes	**Funding:** research grant from the French Ministry of Health CRC12002 and sponsored by the Department of Clinical Research and Development of the Public Assistance Hospital of Paris **Declarations of interest:** none Standard error of the mean (SEM) rather than standard deviation (SD) used throughout paper despite being referred to as SD.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Web-based, permutated blocks of 4 stratified by centre and parity.
Allocation concealment (selection bias)	Low risk	"Allocation was based on permutated blocks of 4 and was stratified by center and parity (primiparous/multiparous). This strategy was not known by local investigators." "As soon as the written consent was signed, the randomization was performed by an automated web-based system to ensure allocation concealment (24-hour accessibility with personal login and password: Cleanweb software; Telemedicine Technologies S.A, Boulogne-Billancourt, France)."
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes "Midwives and obstetricians random [sic] assigned the women and conducted the vaginal and ultrasound examinations at inclusion, at the end of the first hour after randomization, and at complete cervical dilation. They also prospectively collected fetal head position at birth and details about the postures that were used by each woman (number and description of each) and about manual rotation and FHR [fetal heart rate] signal loss."
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome group: all outcomes

Le Ray 2016 *(Continued)*

		"Midwives and obstetricians random assigned the women and conducted the vaginal and ultrasound examinations at inclusion, at the end of the first hour after randomization, and at complete cervical dilation. They also prospectively collected fetal head position at birth and details about the postures that were used by each woman (number and description of each) and about manual rotation and FHR signal loss."
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome group: all outcomes 2.2% loss to follow-up for the primary outcome (5 in the intervention group and 9 in the control group did not complete the intervention).
Selective reporting (reporting bias)	Low risk	Outcomes: appears all outcomes were reported (no differences found, so selective reporting would not be an issue).
Other bias	Low risk	No other bias identified.

Liu 2018

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 226 **Setting:** Obstetrical Department, Affiliated Hospital of Jiangsu University **Study dates:** January 2015 to June 2017 **Inclusion criteria:** 1) age ≥ 20 years, 2) singleton pregnancy, 3) 37 weeks' gestation, 4) planned vaginal birth, 5) including those with a cephalic presentation and full cervical dilatation, 6) occiput posterior position confirmed by ultrasound according to the angle of < 45° between the occiput and midline during the active phase of the 1st stage of labour. **Exclusion criteria:** 1) clinical suspicion of cephalo-pelvic disproportion, 2) history of caesarean section, 3) brow or face presentation, 4) known of suspected chorioamnionitis, 5) pre-existing maternal diabetes, 6) suspected fetal bleeding disorder, 7) known major anatomical fetal abnormality
Interventions	**Experimental intervention:** when cervical dilatation reached 8 cm to 10 cm, pregnant women were positioned in extreme flexion and hip abduction combined with contralateral (opposite side to fetus) side-lying. Foot of upper leg placed on foot pedal so knee as close as possible to abdomen. Total number randomised: n = 114. **Control/comparison intervention:** when cervical dilatation reached 8 cm to 10 cm, pregnant women were positioned in contralateral side (opposite side to fetus) side-lying alone, without extreme flexion and hip abduction. Lower leg was straight and upper leg was flexed less than 90°. Total number randomised: n = 112.
Outcomes	**Outcomes:** 1) successful correction (anterior rotation) of fetus, 2) duration of time from initial (attempt at) correction to successful correction, 3) mode of delivery: spontaneous vaginal, assisted vaginal, caesarean, 4) duration of 1st, 2nd, 3rd stage labour, 5) postpartum mean blood loss within 2 hours, 6) Apgar score (8 to 10 normal newborn, 4 to 7 mild asphyxia, ≤ 3 severe).
Notes	**Funding:** Funding Program for Social Development (SH2014038), Health and Family Planning Commission, Government of Zhenjiang, China **Declarations of interest:** none

Liu 2018 *(Continued)*

	Apgar scores provided but no time frame, e.g. whether taken at 1 minute or 5 minutes.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random digit table.
Allocation concealment (selection bias)	Unclear risk	Not clear whether the same person providing care was responsible for allocation, or whether random digit table visible.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes Not stated but probably not possible to blind participants or personnel given the labour care within study group allocations.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Outcome group: all outcomes Not stated.
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome group: all outcomes Not an intention-to-treat analysis. The loss to follow-up in both groups was < 10%: 9 (7.8%) in the study group due to discontinued intervention following fetal distress and 7 (6.25%) in the control group (5 due to fetal distress and 2 due to prolongation of latent phase). The baseline characteristics are balanced between 2 groups after loss to follow-up.
Selective reporting (reporting bias)	Unclear risk	Outcomes: no pre-trial registration or protocol so unclear if all planned outcomes were reported.
Other bias	Low risk	No other bias identified.

Molina-Reyes 2014

Study characteristics

Methods	RCT
Participants	**Number of women randomised:** 146 **Setting:** a randomised, open, controlled, and multicentre clinical trial was designed in three hospitals of the public network of Andalusia, in the hospitals of Baza and Guadix, in Granada, and Úbedaenjaén. **Study dates:** 01 January 2010 to 30 June 2011 **Inclusion criteria:** • Pregnant women in the active phase of childbirth and diagnosed with persistent OP fetal position • Diagnosis of the fetal position made by the midwife who attended to the pregnant woman by performing a vaginal examination • Persistent OP was considered when the fetus had not rotated to OA and the dilation of the cervix was equal to or greater than 8 cm or a lower dilation without progression of labour for at least 2 hours with adequate uterine dynamics (3 to 5 contractions in 10 minutes). • The diagnosis was confirmed by abdominal ultrasound or vaginal examination by another midwife or gynaecologist.

Molina-Reyes 2014 *(Continued)*

- Pregnant women with a single fetus greater than 37 weeks of gestation, who met the conditions of the definition of the study subjects and agreed to participate voluntarily in the study.

Exclusion criteria: maternal or fetal causes that prevented the intervention (active metrorrhagia, indication of urgent caesarean section due to fetal suffering), non-adoption of the assigned posture due to loss of muscle strength in lower limbs secondary to the administration of epidural analgesia, or twin pregnancies.

Interventions	**Experimental intervention:** the women adopted the hands and knees position on the bed. They were given the option to support their hands on the mattress, their forearms on the bed's headboard, or their thorax on a ball such as a “fit-ball” type. The assigned posture was to be maintained for a minimum of 30 minutes, if the fetus had not yet rotated to OA. After the intervention, the woman could adopt any position she wanted. Total number randomised: n = 76. **Control/comparison intervention:** the decubitus lateral (DL) posture towards the fetal back, lying on their right side when the fetus was in the right OP position and on their left side if the fetus was in the left OP position or direct OP. If after 30 minutes, the fetus had not rotated from direct OP to OA, they would adopt the right DL. The assigned posture was to be maintained for a minimum of 30 minutes, if the fetus had not yet rotated to OA. After the intervention, the woman could adopt any position she wanted. Total number randomised: n = 70.
Outcomes	Fetal rotation from OP to OA (rotation during the intervention, rotation after the intervention, non-rotation); type of termination of delivery (normal vaginal delivery, instrumental delivery, caesarean section); duration of the intervention (minutes), duration of the first stage of labour (minutes), duration of the second stage of labour (minutes); epidural use; and satisfaction with birth experience using the Care in Obstetrics: Measure for Testing Satisfaction (COMFORTS) Scale – very dissatisfied, dissatisfied, moderately satisfied recoded as unsatisfied, and satisfied, very satisfied recoded as satisfied; pain level during the adoption of the given posture compared to pain before adopting it (less, equal, greater); comfort with assigned posture (very comfortable, moderately comfortable, comfortable were recoded as comfortable, and very uncomfortable, uncomfortable were recoded as uncomfortable).
Notes	**Funding:** Ministry of Innovation and Science (Spain), Call for Evaluation of Sanitary Technologies and Health Services (PI09 / 90739); and the Ría de Salud de Andalucía (PI-0336). **Declarations of interest:** none

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	After signing the informed consent and to assign the position by simple randomisation, the midwife consulted the list of random numbers created with a 1:1 ratio of the groups for each centre by means of a computer program, corresponding the number "1" to the Hands and Knees (Manos y Rodillas MR) group and the "2" to the Decubitus Lateral (DL) group.
Allocation concealment (selection bias)	High risk	No. “The midwife consulted the list of random numbers.”
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes Open label study. "Due to the physical nature of the intervention, after its assignment, it could not be masked to the participant or the midwife"
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome group: all outcomes “Due to the physical nature of the intervention, after its assignment, it could not be masked to the participant or the midwife" The midwife collected the data in a data collection notebook, and the closed Likert response questionnaire on women's pain and comfort. The satisfaction questionnaire was com-

Molina-Reyes 2014 *(Continued)*

		pleted by the woman after discharge and then returned to the unit staff and collected by the research team.
Incomplete outcome data (attrition bias) All outcomes	High risk	Outcome group: all outcomes For the analysis of operative birth (primary outcome) and the other outcomes reported in the main paper, 14.5% of the intervention group participants were lost and no control group participants were lost. Baseline characteristics: “administration of epidural analgesia" and "maternal parity” were imbalanced between the 2 groups. There was no intention-to-treat analysis.
Selective reporting (reporting bias)	Low risk	It seems that all outcomes specified have been reported.
Other bias	Low risk	No other bias identified.

Stremler 2005

Study characteristics	
Methods	RCT
Participants	**Number of women randomised:** 147 **Setting:** 13 university-affiliated hospitals in Argentina, Australia, Canada, England, Israel, and the USA **Study dates:** 28-month period in 2000 to 2002. **Inclusion criteria:** in hospital, in early or active labour with a singleton pregnancy in cephalic presentation at ≥ 37 weeks’ gestation, with occipito-posterior position of the fetal head confirmed by ultrasound examination. **Exclusion criteria:** second stage of labour expected within 1 hour, complications of pregnancy or any other contraindication to assuming hands and knees position (such as immobilising anaesthesia), planned caesarean delivery, or known major fetal congenital anomalies.
Interventions	**Experimental intervention:** women assigned to the hands and knees position were asked to maintain the posture for as much time as possible over a period of 60 minutes, for a minimum of 30 minutes in total. After the study period, the woman was encouraged to use the hands and knees position whenever she wished for the remainder of labour. Total number randomised: n = 70. **Control/Comparison intervention:** women were able to use any position except hands and knees position or any position that suspended the maternal abdomen. Women were asked not to assume hands and knees position at any time during the study period and were not actively encouraged to use this position at any other time in labour. Total number randomised: n = 77.
Outcomes	Fetal head rotation assessed by ultrasound 1 hour after randomisation (or if not done, assessed clinically at delivery before any rotational intervention used), persistent back pain by the Short Form McGill Pain Questionnaire SF-MPQ, compliance with allocation position (adherence to trial protocol) and maternal evaluation of positions used by questionnaire also containing the Labour Agentry Scale, operative delivery, perineal trauma, time from randomisation to delivery, Apgar score at 1 and 5 mins.
Notes	**Funding:** grants from the Canadian Institutes of Health Research (CIHR), Ottawa, Ontario (grant MCT 50421), the American Nurses Foundation/Sigma Theta Tau International, Washington, DC, and Indianapolis, Indiana (Nurse Scholar award 99–123), the Faculty of Nursing, University of Toronto, and the Registered Nurses Foundation of Ontario, Toronto. **Declarations of interest:** not reported

Stremler 2005 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"The randomization scheme included prognostic stratification for parity (nullipara or multipara) and anaesthesia use (epidural or no epidural), incorporated random block sizes of 4 and 6 and was centrally controlled with the use of a telephone-based, computerized, randomization system. After the caller entered baseline data, group assignment was delivered by computerized voice message, and was automatically recorded along with baseline information in a separate database table."
Allocation concealment (selection bias)	Low risk	As above.
Blinding of participants and personnel (performance bias) All outcomes	High risk	Outcome group: all outcomes "Because of the nature of the intervention, participants and caregivers could not be blinded."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome group: all outcomes Clinicians who placed the telephone call to obtain group allocation were not permitted to perform the final ultrasound scan to determine the primary outcome. Nurses, midwives, and labouring women were instructed not to reveal group assignments to the clinician performing the final ultrasound examination, and clinicians were asked not to seek out the labouring woman's assignment. Although the clinician may also have provided care to the labouring woman, it was rare that the woman needed to be assessed during the short interval between ultrasound scans. Forms were sealed so that the clinician recording the ultrasound results was unable to access data sheets indicating the woman's group assignment and pain scores. Research assistants collecting data from chart review and scanning data into the computer database were unaware of group allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome group: all outcomes 3 deviations from intended intervention in control group and 1 in intervention group; however, no missing data for primary outcome.
Selective reporting (reporting bias)	Low risk	No protocol available in ClinicalTrials.gov or World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP). Protocol section within the study report only details inclusion/exclusion factors but not outcomes to be measured. However, primary outcome (fetal position 1 hour after randomisation) was fully reported and in cases of women delivering before then, it was reported as position just prior to manual rotation or at delivery. Additional outcomes measured (perineal trauma, Apgar score at 1 minute and 5 minutes, and duration from randomisation to delivery were only aforementioned as "other labour & delivery outcomes".
Other bias	Low risk	Nothing to suggest other forms of bias.

BMI: body mass index; **min(s):** minute(s); **OA:** occipito-anterior; **OP:** occipito-posterior; **RCT:** randomised controlled trial

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Andrews 1981	Participants not in labour
Kariminia 2004	Participants not in labour
Zhang 2017	Participants not specifically women with an occipito-posterior or occipito-transverse malposition

Characteristics of studies awaiting classification *[ordered by study ID]*

Lu 2001

Methods	RCT
Participants	**Setting:** delivery room of Shandong Provincial Hospital, Jinan, China **Study dates:** February 1999 to April 2000 **Inclusion criteria:** nulliparous pregnant women with a singleton pregnancy, aged 23 to 35 years, 37 to 40 weeks' gestation, normal pelvis size, no signs of complications of pregnancy, pelvis score (cervical dilatation) ≥ 7 cm, B-ultrasound confirmed OP/OT position. **Exclusion criteria:** not stated
Interventions	**Experimental intervention:** women were instructed to lie lateral-prone on the same side as the fetal spine during labour, with legs flexed and the abdomen resting on the mattress. Total number randomised: n = 108. **Control/comparison intervention**: women could move freely or stay in bed with no specific instruction. Total number randomised: n = 108.
Outcomes	Successful anterior rotation, mode of delivery, duration of first and second stage labour.
Notes	

Ou 1997

Methods	RCT
Participants	**Setting:** Giangzhou Second People's Hospital, Guangzhou, China **Study dates:** March 1994 to December 1995 **Inclusion criteria**: nulliparous pregnant women with a singleton pregnancy, aged 23 to 35 years, 37 to 40 weeks' gestation, cephalic presentation, normal pelvis size, no signs of complications of pregnancy, pelvis score (cervical dilatation) ≥ 7 cm, B-ultrasound confirmed the OP position **Exclusion criteria**: not stated
Interventions	**Experimental intervention:** women were instructed to lie in a lateral posture on the same side as the fetal spine, knees flexed and directed towards the chest, the thighs at right angles to the body, the anterior abdominal wall rested on the mattress. Total number randomised: n = 120. **Control/comparison intervention:** women could move freely, or lay on the bed without specific instruction. Total number randomised: n = 120.

Ou 1997 *(Continued)*

Outcomes	Mode of delivery, fetal malposition (OP/OT) after the intervention, duration of labour, birthweight, Apgar scores
Notes	

Wu 2001

Methods	RCT
Participants	**Setting:** maternity unit in the hospital **Study dates:** 01 January 2000 to 31 July 2000 **Inclusion criteria:** nulliparous pregnant women, singleton pregnancy, 21 to 34 years old, 37 to 41 weeks' gestation, cephalic presentation, normal-sized pelvis, no signs of cephalopelvic disproportion, no comorbidities/complications of pregnancy, head to pelvis score (cervical dilatation) > 7 cm, OP fetal position confirmed by B-ultrasound **Exclusion criteria:** not stated
Interventions	**Experimental intervention:** ipsilateral decubitus (side-lying on same side as fetus) with 30° to 45° slope to the bed, upper knee flexed to chest, lower leg straightened, abdomen rests on the bed. Total number randomised: n = 50. **Control/comparison intervention**: contralateral decubitus position (side-lying on opposite side to fetal spine). Total number randomised: n = 50.
Outcomes	Operative birth, fetal malposition (OT/OP) after the intervention, duration of labour (in hours)
Notes	

OP: occipito-posterior; **OT:** occipito-transverse

DATA AND ANALYSES

Comparison 1. Hands and knees posture versus other postures

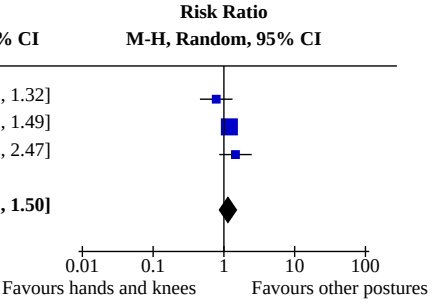
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	3	721	Risk Ratio (M-H, Random, 95% CI)	1.14 [0.87, 1.50]
1.2 Fetal malposition (OP/OT) after the intervention	3	688	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.87, 1.00]
1.3 Duration of labour	3	721	Mean Difference (IV, Fixed, 95% CI)	-0.26 [-0.75, 0.22]
1.4 Oxytocin augmentation	1	147	Risk Ratio (M-H, Fixed, 95% CI)	0.86 [0.57, 1.30]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.5 Pain score (as defined by trialists using standardised tools available)	1	110	Risk Ratio (M-H, Fixed, 95% CI)	0.41 [0.17, 1.01]
1.6 Pain score (as defined by trialists using standardised tools available	1	439	Mean Difference (IV, Fixed, 95% CI)	0.05 [-0.29, 0.39]
1.7 Improved comfort	1	411	Risk Ratio (M-H, Fixed, 95% CI)	1.75 [1.25, 2.46]
1.8 Epidural use	2	282	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.41, 1.31]
1.9 Occipito-posterior/transverse position at birth	2	257	Risk Ratio (M-H, Fixed, 95% CI)	0.81 [0.55, 1.20]
1.10 Caesarean section	3	721	Risk Ratio (M-H, Fixed, 95% CI)	1.34 [0.96, 1.87]
1.11 Instrumental vaginal birth	3	721	Risk Ratio (M-H, Random, 95% CI)	1.04 [0.57, 1.90]
1.12 Episiotomy	1	147	Risk Ratio (M-H, Fixed, 95% CI)	1.15 [0.70, 1.91]
1.13 Severe perineal tears (3rd degree or higher, as defined by trialists)	2	586	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.03, 22.30]
1.14 Maternal satisfaction (as defined by trialists using standardised tools available)	3	350	Risk Ratio (M-H, Random, 95% CI)	1.02 [0.68, 1.54]
1.15 Maternal satisfaction (as defined by trialists using standardised tools available)	1	138	Mean Difference (IV, Fixed, 95% CI)	-0.54 [-4.13, 3.05]
1.16 Apgar scores less than seven at five minutes	2	586	Risk Ratio (M-H, Fixed, 95% CI)	0.71 [0.21, 2.34]

Analysis 1.1. Comparison 1: Hands and knees posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Stremler 2005	17	70	24	77	20.8%	0.78 [0.46 , 1.32]
Guittier 2016	102	220	85	219	58.2%	1.19 [0.96 , 1.49]
Molina-Reyes 2014	23	65	17	70	21.0%	1.46 [0.86 , 2.47]
Total (95% CI)		**355**		**366**	**100.0%**	**1.14 [0.87 , 1.50]**
Total events:	142		126			

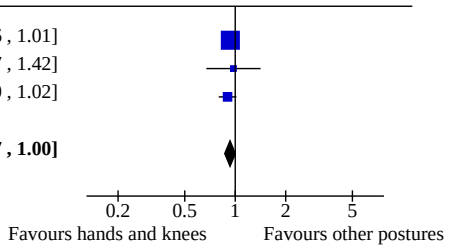
Heterogeneity: Tau² = 0.02; Chi² = 2.95, df = 2 (P = 0.23); I² = 32%
Test for overall effect: Z = 0.93 (P = 0.35)
Test for subgroup differences: Not applicable



Analysis 1.2. Comparison 1: Hands and knees posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Guittier 2016	168	203	185	209	65.4%	0.93 [0.86 , 1.01]
Molina-Reyes 2014	29	65	32	70	11.1%	0.98 [0.67 , 1.42]
Stremler 2005	57	68	68	73	23.5%	0.90 [0.80 , 1.02]
Total (95% CI)		**336**		**352**	**100.0%**	**0.93 [0.87 , 1.00]**
Total events:	254		285			

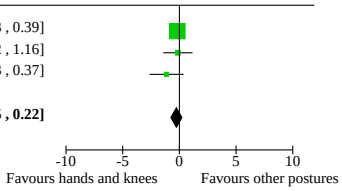
Heterogeneity: Chi² = 0.38, df = 2 (P = 0.83); I² = 0%
Test for overall effect: Z = 1.92 (P = 0.05)
Test for subgroup differences: Not applicable



Analysis 1.3. Comparison 1: Hands and knees posture versus other postures, Outcome 3: Duration of labour

Study or Subgroup	Hands and knees Mean [Hours]	SD [Hours]	Total	Other postures Mean [Hours]	SD [Hours]	Total	Weight	Mean Difference IV, Fixed, 95% CI [Hours]
Guittier 2016	6.7	3.28	220	6.87	2.68	219	75.3%	-0.17 [-0.73 , 0.39]
Molina-Reyes 2014	7.99	4.01	65	8.12	3.58	70	14.3%	-0.13 [-1.42 , 1.16]
Stremler 2005	5.47	4.31	70	6.6	4.99	77	10.4%	-1.13 [-2.63 , 0.37]
Total (95% CI)			**355**			**366**	**100.0%**	**-0.26 [-0.75 , 0.22]**

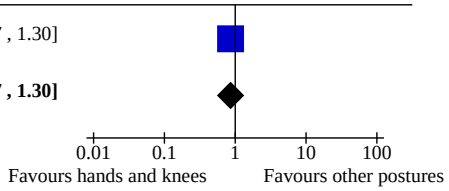
Heterogeneity: Chi² = 1.42, df = 2 (P = 0.49); I² = 0%
Test for overall effect: Z = 1.07 (P = 0.29)
Test for subgroup differences: Not applicable



Analysis 1.4. Comparison 1: Hands and knees posture versus other postures, Outcome 4: Oxytocin augmentation

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Stremler 2005	25	70	32	77	100.0%	0.86 [0.57 , 1.30]
Total (95% CI)		**70**		**77**	**100.0%**	**0.86 [0.57 , 1.30]**
Total events:	25		32			

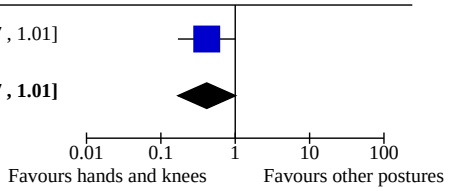
Heterogeneity: Not applicable
Test for overall effect: Z = 0.72 (P = 0.47)
Test for subgroup differences: Not applicable



Analysis 1.5. Comparison 1: Hands and knees posture versus other postures, Outcome 5: Pain score (as defined by trialists using standardised tools available)

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Molina-Reyes 2014	6	58	13	52	100.0%	0.41 [0.17 , 1.01]
Total (95% CI)		**58**		**52**	**100.0%**	**0.41 [0.17 , 1.01]**
Total events:	6		13			

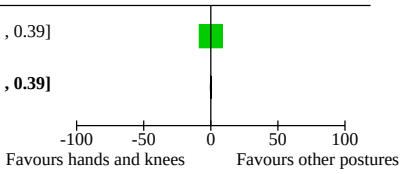
Heterogeneity: Not applicable
Test for overall effect: Z = 1.94 (P = 0.05)
Test for subgroup differences: Not applicable



Analysis 1.6. Comparison 1: Hands and knees posture versus other postures, Outcome 6: Pain score (as defined by trialists using standardised tools available

Study or Subgroup	Hands and knees Mean	SD	Total	Other postures Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Guittier 2016	2.9	1.81	220	2.85	1.81	219	100.0%	0.05 [-0.29 , 0.39]
Total (95% CI)			**220**			**219**	**100.0%**	**0.05 [-0.29 , 0.39]**

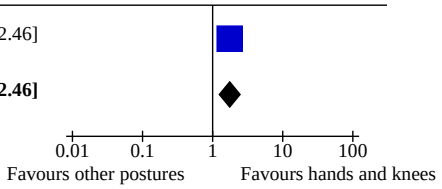
Heterogeneity: Not applicable
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



Analysis 1.7. Comparison 1: Hands and knees posture versus other postures, Outcome 7: Improved comfort

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Guittier 2016	70	208	39	203	100.0%	1.75 [1.25 , 2.46]
Total (95% CI)		**208**		**203**	**100.0%**	**1.75 [1.25 , 2.46]**
Total events:	70		39			

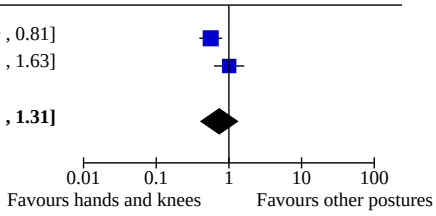
Heterogeneity: Not applicable
Test for overall effect: Z = 3.23 (P = 0.001)
Test for subgroup differences: Not applicable



Analysis 1.8. Comparison 1: Hands and knees posture versus other postures, Outcome 8: Epidural use

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Molina-Reyes 2014	24	65	46	70	53.8%	0.56 [0.39 , 0.81]
Stremler 2005	22	70	24	77	46.2%	1.01 [0.62 , 1.63]
Total (95% CI)		**135**		**147**	**100.0%**	**0.74 [0.41 , 1.31]**
Total events:	46		70			

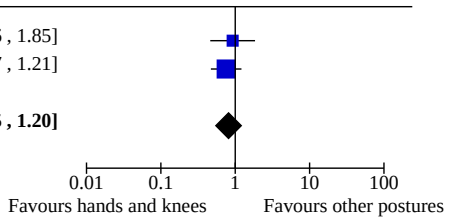
Heterogeneity: Tau² = 0.13; Chi² = 3.69, df = 1 (P = 0.05); I² = 73%
Test for overall effect: Z = 1.04 (P = 0.30)
Test for subgroup differences: Not applicable



Analysis 1.9. Comparison 1: Hands and knees posture versus other postures, Outcome 9: Occipito-posterior/transverse position at birth

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Molina-Reyes 2014	12	65	14	70	34.5%	0.92 [0.46 , 1.85]
Stremler 2005	19	60	26	62	65.5%	0.76 [0.47 , 1.21]
Total (95% CI)		**125**		**132**	**100.0%**	**0.81 [0.55 , 1.20]**
Total events:	31		40			

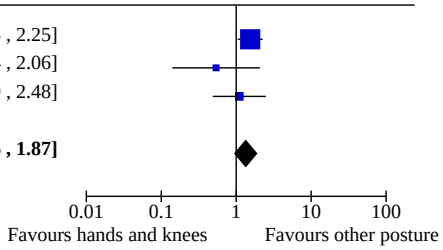
Heterogeneity: Chi² = 0.22, df = 1 (P = 0.64); I² = 0%
Test for overall effect: Z = 1.03 (P = 0.30)
Test for subgroup differences: Not applicable



Analysis 1.10. Comparison 1: Hands and knees posture versus other postures, Outcome 10: Caesarean section

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Guittier 2016	54	220	35	219	69.6%	1.54 [1.05 , 2.25]
Molina-Reyes 2014	3	65	6	70	11.5%	0.54 [0.14 , 2.06]
Stremler 2005	10	70	10	77	18.9%	1.10 [0.49 , 2.48]
Total (95% CI)		**355**		**366**	**100.0%**	**1.34 [0.96 , 1.87]**
Total events:	67		51			

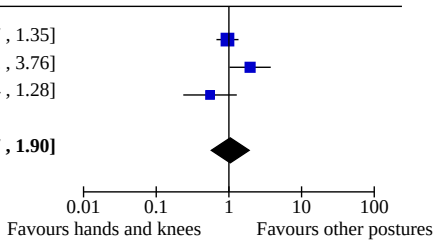
Heterogeneity: Chi² = 2.48, df = 2 (P = 0.29); I² = 19%
Test for overall effect: Z = 1.72 (P = 0.08)
Test for subgroup differences: Not applicable



Analysis 1.11. Comparison 1: Hands and knees posture versus other postures, Outcome 11: Instrumental vaginal birth

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Guittier 2016	48	220	50	219	43.3%	0.96 [0.67 , 1.35]
Molina-Reyes 2014	20	65	11	70	31.6%	1.96 [1.02 , 3.76]
Stremler 2005	7	70	14	77	25.1%	0.55 [0.24 , 1.28]
Total (95% CI)		**355**		**366**	**100.0%**	**1.04 [0.57 , 1.90]**
Total events:	75		75			

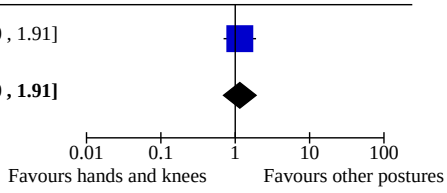
Heterogeneity: Tau² = 0.18; Chi² = 5.99, df = 2 (P = 0.05); I² = 67%
Test for overall effect: Z = 0.14 (P = 0.89)
Test for subgroup differences: Not applicable



Analysis 1.12. Comparison 1: Hands and knees posture versus other postures, Outcome 12: Episiotomy

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Stremler 2005	22	70	21	77	100.0%	1.15 [0.70 , 1.91]
Total (95% CI)		**70**		**77**	**100.0%**	**1.15 [0.70 , 1.91]**
Total events:	22		21			

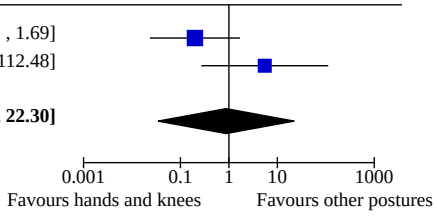
Heterogeneity: Not applicable
Test for overall effect: Z = 0.55 (P = 0.58)
Test for subgroup differences: Not applicable



Analysis 1.13. Comparison 1: Hands and knees posture versus other postures, Outcome 13: Severe perineal tears (3rd degree or higher, as defined by trialists)

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Guittier 2016	1	220	5	219	55.4%	0.20 [0.02 , 1.69]
Stremler 2005	2	70	0	77	44.6%	5.49 [0.27 , 112.48]
Total (95% CI)		**290**		**296**	**100.0%**	**0.88 [0.03 , 22.30]**
Total events:	3		5			

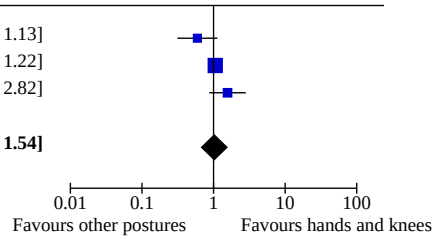
Heterogeneity: Tau² = 3.74; Chi² = 3.10, df = 1 (P = 0.08); I² = 68%
Test for overall effect: Z = 0.08 (P = 0.94)
Test for subgroup differences: Not applicable



Analysis 1.14. Comparison 1: Hands and knees posture versus other postures, Outcome 14: Maternal satisfaction (as defined by trialists using standardised tools available)

Study or Subgroup	Hands and knees Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bahmaei 2018	9	42	31	86	23.1%	0.59 [0.31 , 1.13]
Molina-Reyes 2014	35	38	41	47	51.4%	1.06 [0.91 , 1.22]
Stremler 2005	21	67	14	70	25.5%	1.57 [0.87 , 2.82]
Total (95% CI)		**147**		**203**	**100.0%**	**1.02 [0.68 , 1.54]**
Total events:	65		86			

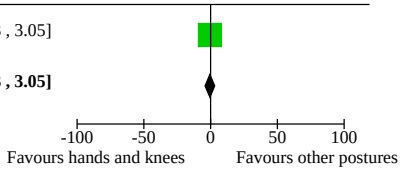
Heterogeneity: Tau² = 0.08; Chi² = 4.95, df = 2 (P = 0.08); I² = 60%
Test for overall effect: Z = 0.11 (P = 0.91)
Test for subgroup differences: Not applicable



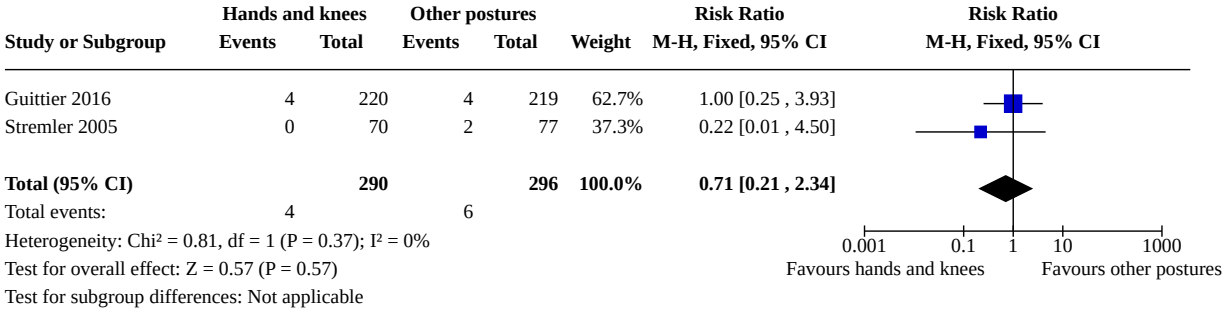
Analysis 1.15. Comparison 1: Hands and knees posture versus other postures, Outcome 15: Maternal satisfaction (as defined by trialists using standardised tools available)

Study or Subgroup	Hands and knees Mean	SD	Total	Other postures Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Stremler 2005	49.58	10.3	68	50.12	11.22	70	100.0%	-0.54 [-4.13 , 3.05]
Total (95% CI)			**68**			**70**	**100.0%**	**-0.54 [-4.13 , 3.05]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



Analysis 1.16. Comparison 1: Hands and knees posture versus other postures, Outcome 16: Apgar scores less than seven at five minutes



Comparison 2. Any lateral posture versus other postures

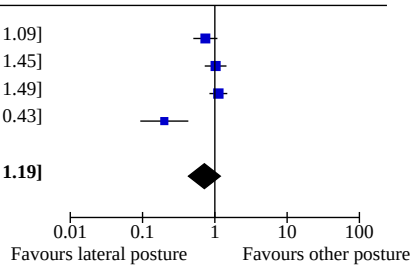
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	4	871	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.43, 1.19]
2.2 Fetal malposition (OP/OT) after the intervention	4	864	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.46, 1.08]
2.3 Duration of labour	2	430	Mean Difference (IV, Random, 95% CI)	-0.36 [-1.23, 0.50]
2.4 Oxytocin augmentation	1	220	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.85, 1.02]
2.5 Pain score (as defined by trialists using standardised tools)	1	322	Mean Difference (IV, Fixed, 95% CI)	0.10 [-0.28, 0.48]
2.6 Occipito-posterior/transverse position at birth	3	749	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.25, 1.60]
2.7 Caesarean section	4	871	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.44, 1.39]
2.8 Instrumental vaginal birth	4	871	Risk Ratio (M-H, Random, 95% CI)	0.73 [0.39, 1.36]
2.9 Episiotomy	3	609	Risk Ratio (M-H, Fixed, 95% CI)	0.94 [0.74, 1.20]
2.10 Severe perineal tears (3rd degree or higher, as defined by trialists)	3	609	Risk Ratio (M-H, Fixed, 95% CI)	0.66 [0.17, 2.48]
2.11 Postpartum haemorrhage (as defined by trialists)	1	322	Risk Ratio (M-H, Fixed, 95% CI)	0.90 [0.48, 1.70]
2.12 Maternal satisfaction (as defined by trialists using standardised tools available)	2	451	Risk Ratio (M-H, Fixed, 95% CI)	0.96 [0.84, 1.09]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.13 Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists)	3	752	Risk Ratio (M-H, Fixed, 95% CI)	1.41 [0.64, 3.12]
2.14 Apgar scores less than seven at five minutes	1	322	Risk Ratio (M-H, Fixed, 95% CI)	0.25 [0.03, 2.24]
2.15 Admission to neonatal intensive care	2	542	Risk Ratio (M-H, Fixed, 95% CI)	1.41 [0.64, 3.12]
2.16 Birth trauma (as defined by trialists)	1	220	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.09]

Analysis 2.1. Comparison 2: Any lateral posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Study or Subgroup	Any lateral posture Events	Total	Other posture Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	24	59	33	60	26.4%	0.74 [0.50 , 1.09]
Desbriere 2013	41	110	40	110	27.1%	1.02 [0.73 , 1.45]
Le Ray 2016	63	160	57	162	28.3%	1.12 [0.84 , 1.49]
Liu 2018	7	105	35	105	18.2%	0.20 [0.09 , 0.43]
Total (95% CI)		**434**		**437**	**100.0%**	**0.72 [0.43 , 1.19]**
Total events:	135		165			

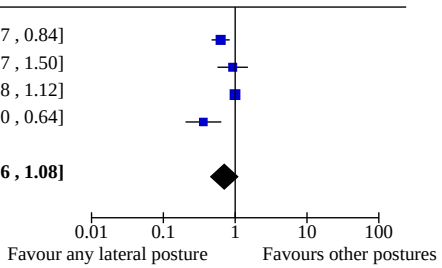
Heterogeneity: Tau² = 0.21; Chi² = 19.43, df = 3 (P = 0.0002); I² = 85%
Test for overall effect: Z = 1.29 (P = 0.20)
Test for subgroup differences: Not applicable



Analysis 2.2. Comparison 2: Any lateral posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	29	59	47	60	27.3%	0.63 [0.47 , 0.84]
Desbriere 2013	24	110	26	110	22.2%	0.92 [0.57 , 1.50]
Le Ray 2016	121	156	124	159	30.5%	0.99 [0.88 , 1.12]
Liu 2018	13	105	36	105	20.0%	0.36 [0.20 , 0.64]
Total (95% CI)		**430**		**434**	**100.0%**	**0.70 [0.46 , 1.08]**
Total events:	187		233			

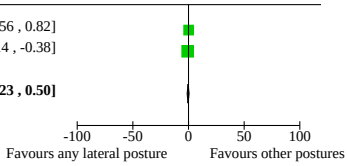
Heterogeneity: Tau² = 0.15; Chi² = 22.08, df = 3 (P < 0.0001); I² = 86%
Test for overall effect: Z = 1.60 (P = 0.11)
Test for subgroup differences: Not applicable



Analysis 2.3. Comparison 2: Any lateral posture versus other postures, Outcome 3: Duration of labour

Study or Subgroup	Any lateral posture Mean [Hours]	SD [Hours]	Total	Other postures Mean [Hours]	SD [Hours]	Total	Weight	Mean Difference IV, Random, 95% CI [Hours]
Desbriere 2013	4.1	2.82	110	3.97	2.4	110	44.5%	0.13 [-0.56 , 0.82]
Liu 2018	8.92	1.48	105	9.68	1.34	105	55.5%	-0.76 [-1.14 , -0.38]
Total (95% CI)			**215**			**215**	**100.0%**	**-0.36 [-1.23 , 0.50]**

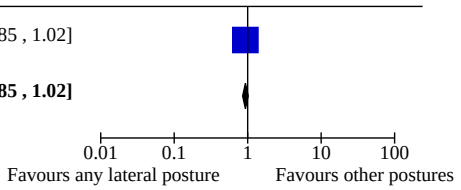
Heterogeneity: Tau² = 0.31; Chi² = 4.87, df = 1 (P = 0.03); I² = 79%
Test for overall effect: Z = 0.82 (P = 0.41)
Test for subgroup differences: Not applicable



Analysis 2.4. Comparison 2: Any lateral posture versus other postures, Outcome 4: Oxytocin augmentation

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	96	110	103	110	100.0%	0.93 [0.85 , 1.02]
Total (95% CI)		**110**		**110**	**100.0%**	**0.93 [0.85 , 1.02]**
Total events:	96		103			

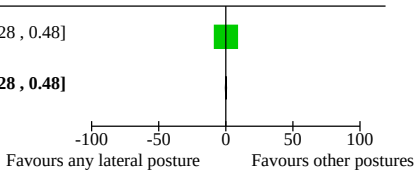
Heterogeneity: Not applicable
Test for overall effect: Z = 1.60 (P = 0.11)
Test for subgroup differences: Not applicable



Analysis 2.5. Comparison 2: Any lateral posture versus other postures, Outcome 5: Pain score (as defined by trialists using standardised tools)

Study or Subgroup	Any lateral posture Mean	SD	Total	Other postures Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Le Ray 2016	1.5	1.84	160	1.4	1.66	162	100.0%	0.10 [-0.28 , 0.48]
Total (95% CI)			**160**			**162**	**100.0%**	**0.10 [-0.28 , 0.48]**

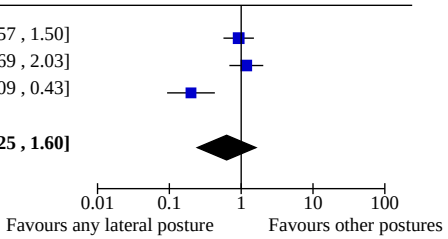
Heterogeneity: Not applicable
Test for overall effect: Z = 0.51 (P = 0.61)
Test for subgroup differences: Not applicable



Analysis 2.6. Comparison 2: Any lateral posture versus other postures, Outcome 6: Occipito-posterior/transverse position at birth

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Desbriere 2013	24	110	26	110	35.0%	0.92 [0.57 , 1.50]
Le Ray 2016	24	157	21	162	34.2%	1.18 [0.69 , 2.03]
Liu 2018	7	105	35	105	30.8%	0.20 [0.09 , 0.43]
Total (95% CI)		**372**		**377**	**100.0%**	**0.63 [0.25 , 1.60]**
Total events:	55		82			

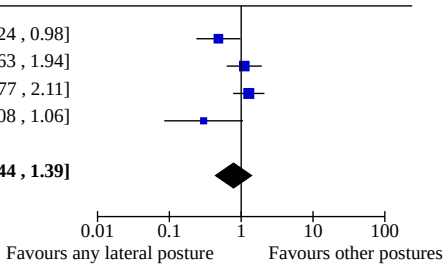
Heterogeneity: Tau² = 0.59; Chi² = 15.31, df = 2 (P = 0.0005); I² = 87%
Test for overall effect: Z = 0.98 (P = 0.33)
Test for subgroup differences: Not applicable



Analysis 2.7. Comparison 2: Any lateral posture versus other postures, Outcome 7: Caesarean section

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	9	59	19	60	25.3%	0.48 [0.24 , 0.98]
Desbriere 2013	21	110	19	110	29.5%	1.11 [0.63 , 1.94]
Le Ray 2016	29	160	23	162	31.3%	1.28 [0.77 , 2.11]
Liu 2018	3	105	10	105	13.8%	0.30 [0.08 , 1.06]
Total (95% CI)		**434**		**437**	**100.0%**	**0.78 [0.44 , 1.39]**
Total events:	62		71			

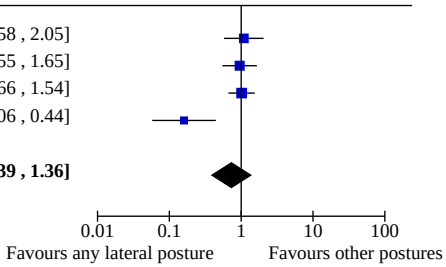
Heterogeneity: Tau² = 0.21; Chi² = 8.33, df = 3 (P = 0.04); I² = 64%
Test for overall effect: Z = 0.84 (P = 0.40)
Test for subgroup differences: Not applicable



Analysis 2.8. Comparison 2: Any lateral posture versus other postures, Outcome 8: Instrumental vaginal birth

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	15	59	14	60	25.4%	1.09 [0.58 , 2.05]
Desbriere 2013	20	110	21	110	27.1%	0.95 [0.55 , 1.65]
Le Ray 2016	34	160	34	162	29.7%	1.01 [0.66 , 1.54]
Liu 2018	4	105	25	105	17.8%	0.16 [0.06 , 0.44]
Total (95% CI)		**434**		**437**	**100.0%**	**0.73 [0.39 , 1.36]**
Total events:	73		94			

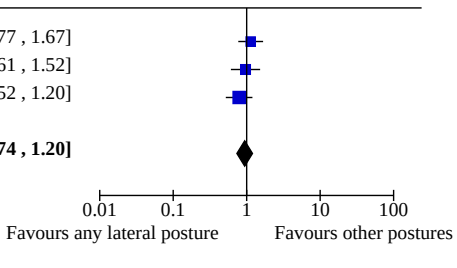
Heterogeneity: Tau² = 0.29; Chi² = 12.26, df = 3 (P = 0.007); I² = 76%
Test for overall effect: Z = 1.00 (P = 0.32)
Test for subgroup differences: Not applicable



Analysis 2.9. Comparison 2: Any lateral posture versus other postures, Outcome 9: Episiotomy

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bueno-Lopez 2018	29	59	26	60	28.1%	1.13 [0.77 , 1.67]
Desbriere 2013	27	110	28	110	30.6%	0.96 [0.61 , 1.52]
Le Ray 2016	29	131	39	139	41.3%	0.79 [0.52 , 1.20]
Total (95% CI)		**300**		**309**	**100.0%**	**0.94 [0.74 , 1.20]**
Total events:	85		93			

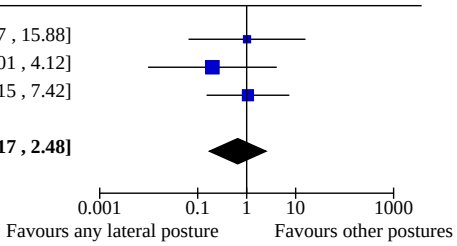
Heterogeneity: Chi² = 1.59, df = 2 (P = 0.45); I² = 0%
Test for overall effect: Z = 0.50 (P = 0.62)
Test for subgroup differences: Not applicable



Analysis 2.10. Comparison 2: Any lateral posture versus other postures, Outcome 10: Severe perineal tears (3rd degree or higher, as defined by trialists)

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bueno-Lopez 2018	1	59	1	60	18.3%	1.02 [0.07 , 15.88]
Desbriere 2013	0	110	2	110	46.0%	0.20 [0.01 , 4.12]
Le Ray 2016	2	131	2	139	35.7%	1.06 [0.15 , 7.42]
Total (95% CI)		**300**		**309**	**100.0%**	**0.66 [0.17 , 2.48]**
Total events:	3		5			

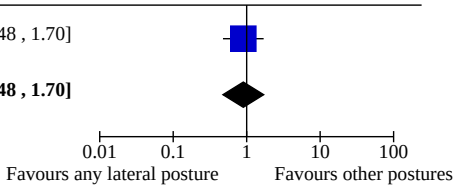
Heterogeneity: Chi² = 0.92, df = 2 (P = 0.63); I² = 0%
Test for overall effect: Z = 0.62 (P = 0.53)
Test for subgroup differences: Not applicable



Analysis 2.11. Comparison 2: Any lateral posture versus other postures, Outcome 11: Postpartum haemorrhage (as defined by trialists)

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	16	160	18	162	100.0%	0.90 [0.48 , 1.70]
Total (95% CI)		**160**		**162**	**100.0%**	**0.90 [0.48 , 1.70]**
Total events:	16		18			

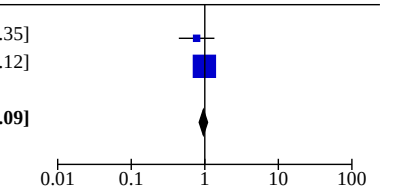
Heterogeneity: Not applicable
Test for overall effect: Z = 0.32 (P = 0.75)
Test for subgroup differences: Not applicable



Analysis 2.12. Comparison 2: Any lateral posture versus other postures, Outcome 12: Maternal satisfaction (as defined by trialists using standardised tools available)

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bahmaei 2018	12	43	31	86	14.5%	0.77 [0.44 , 1.35]
Le Ray 2016	120	160	123	162	85.5%	0.99 [0.87 , 1.12]
Total (95% CI)		**203**		**248**	**100.0%**	**0.96 [0.84 , 1.09]**
Total events:	132		154			

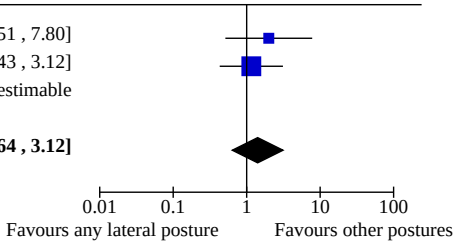
Heterogeneity: Chi² = 0.81, df = 1 (P = 0.37); I² = 0%
Test for overall effect: Z = 0.66 (P = 0.51)
Test for subgroup differences: Not applicable



Analysis 2.13. Comparison 2: Any lateral posture versus other postures, Outcome 13: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists)

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	6	110	3	110	30.1%	2.00 [0.51 , 7.80]
Le Ray 2016	8	160	7	162	69.9%	1.16 [0.43 , 3.12]
Liu 2018	0	105	0	105		Not estimable
Total (95% CI)		**375**		**377**	**100.0%**	**1.41 [0.64 , 3.12]**
Total events:	14		10			

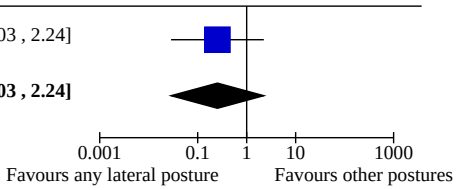
Heterogeneity: Chi² = 0.41, df = 1 (P = 0.52); I² = 0%
Test for overall effect: Z = 0.85 (P = 0.40)
Test for subgroup differences: Not applicable



Analysis 2.14. Comparison 2: Any lateral posture versus other postures, Outcome 14: Apgar scores less than seven at five minutes

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	1	160	4	162	100.0%	0.25 [0.03 , 2.24]
Total (95% CI)		**160**		**162**	**100.0%**	**0.25 [0.03 , 2.24]**
Total events:	1		4			

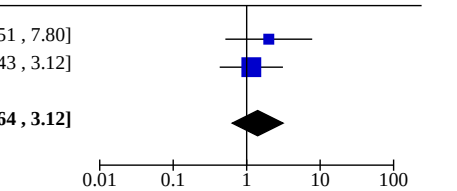
Heterogeneity: Not applicable
Test for overall effect: Z = 1.23 (P = 0.22)
Test for subgroup differences: Not applicable



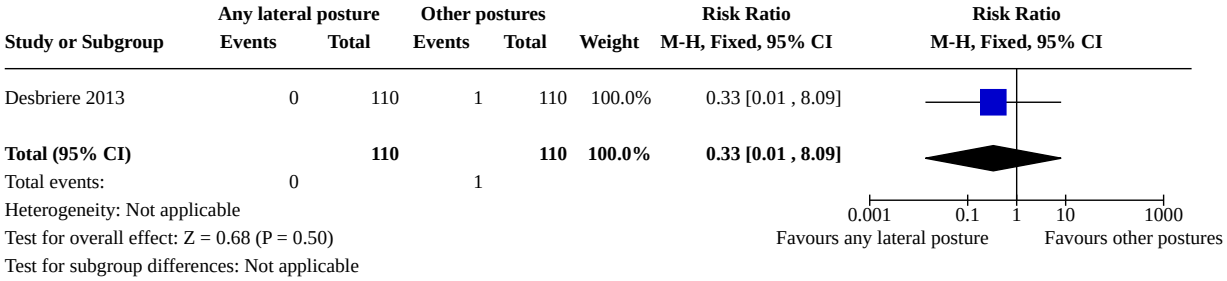
Analysis 2.15. Comparison 2: Any lateral posture versus other postures, Outcome 15: Admission to neonatal intensive care

Study or Subgroup	Any lateral posture Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	6	110	3	110	30.1%	2.00 [0.51 , 7.80]
Le Ray 2016	8	160	7	162	69.9%	1.16 [0.43 , 3.12]
Total (95% CI)		**270**		**272**	**100.0%**	**1.41 [0.64 , 3.12]**
Total events:	14		10			

Heterogeneity: Chi² = 0.41, df = 1 (P = 0.52); I² = 0%
Test for overall effect: Z = 0.85 (P = 0.40)
Test for subgroup differences: Not applicable



Analysis 2.16. Comparison 2: Any lateral posture versus other postures, Outcome 16: Birth trauma (as defined by trialists)



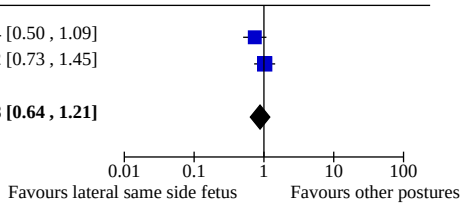
Comparison 3. Lateral posture on same side as fetus versus other postures

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	2	339	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.64, 1.21]
3.2 Fetal malposition (OP/OT) after the intervention	2	339	Risk Ratio (M-H, Random, 95% CI)	0.73 [0.49, 1.07]
3.3 Duration of labour	1	220	Mean Difference (IV, Fixed, 95% CI)	0.13 [-0.56, 0.82]
3.4 Oxytocin augmentation	1	220	Risk Ratio (M-H, Fixed, 95% CI)	0.93 [0.85, 1.02]
3.5 Occipito-posterior/transverse position at birth	1	220	Risk Ratio (M-H, Fixed, 95% CI)	0.92 [0.57, 1.50]
3.6 Caesarean section	2	339	Risk Ratio (M-H, Random, 95% CI)	0.75 [0.33, 1.69]
3.7 Instrumental vaginal birth	2	339	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.66, 1.53]
3.8 Episiotomy	2	339	Risk Ratio (M-H, Fixed, 95% CI)	1.05 [0.77, 1.41]
3.9 Severe perineal tears (3rd degree or higher, as defined by trialists)	2	339	Risk Ratio (M-H, Fixed, 95% CI)	0.43 [0.06, 2.89]
3.10 Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists)	1	220	Risk Ratio (M-H, Fixed, 95% CI)	2.00 [0.51, 7.80]
3.11 Admission to neonatal intensive care	1	220	Risk Ratio (M-H, Fixed, 95% CI)	2.00 [0.51, 7.80]
3.12 Birth trauma (as defined by trialists)	1	220	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.09]

Analysis 3.1. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	24	59	33	60	46.7%	0.74 [0.50 , 1.09]
Desbriere 2013	41	110	40	110	53.3%	1.02 [0.73 , 1.45]
Total (95% CI)		**169**		**170**	**100.0%**	**0.88 [0.64 , 1.21]**
Total events:	65		73			

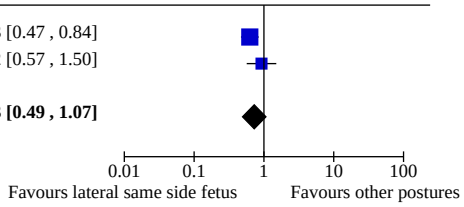
Heterogeneity: Tau² = 0.02; Chi² = 1.54, df = 1 (P = 0.21); I² = 35%
Test for overall effect: Z = 0.78 (P = 0.43)
Test for subgroup differences: Not applicable



Analysis 3.2. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	29	59	47	60	62.1%	0.63 [0.47 , 0.84]
Desbriere 2013	24	110	26	110	37.9%	0.92 [0.57 , 1.50]
Total (95% CI)		**169**		**170**	**100.0%**	**0.73 [0.49 , 1.07]**
Total events:	53		73			

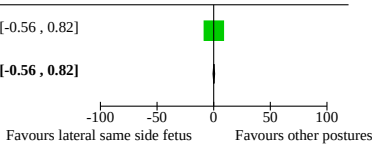
Heterogeneity: Tau² = 0.04; Chi² = 1.95, df = 1 (P = 0.16); I² = 49%
Test for overall effect: Z = 1.63 (P = 0.10)
Test for subgroup differences: Not applicable



Analysis 3.3. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 3: Duration of labour

Study or Subgroup	Lateral same side fetus Mean [Hours]	SD [Hours]	Total	Other postures Mean [Hours]	SD [Hours]	Total	Weight	Mean Difference IV, Fixed, 95% CI [Hours]
Desbriere 2013	4.1	2.82	110	3.97	2.4	110	100.0%	0.13 [-0.56 , 0.82]
Total (95% CI)			**110**			**110**	**100.0%**	**0.13 [-0.56 , 0.82]**

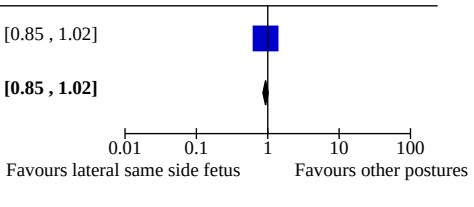
Heterogeneity: Not applicable
Test for overall effect: Z = 0.37 (P = 0.71)
Test for subgroup differences: Not applicable



Analysis 3.4. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 4: Oxytocin augmentation

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	96	110	103	110	100.0%	0.93 [0.85 , 1.02]
Total (95% CI)		**110**		**110**	**100.0%**	**0.93 [0.85 , 1.02]**
Total events:	96		103			

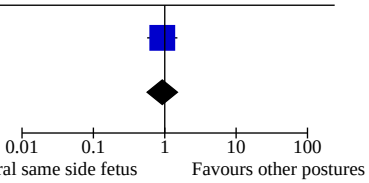
Heterogeneity: Not applicable
Test for overall effect: Z = 1.60 (P = 0.11)
Test for subgroup differences: Not applicable



Analysis 3.5. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 5: Occipito-posterior/transverse position at birth

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	24	110	26	110	100.0%	0.92 [0.57 , 1.50]
Total (95% CI)		**110**		**110**	**100.0%**	**0.92 [0.57 , 1.50]**
Total events:	24		26			

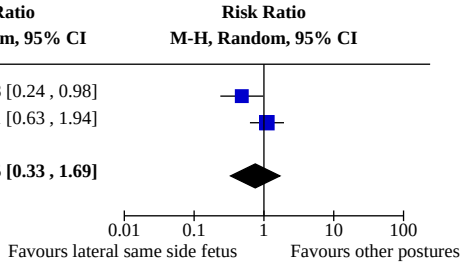
Heterogeneity: Not applicable
Test for overall effect: Z = 0.32 (P = 0.75)
Test for subgroup differences: Not applicable



Analysis 3.6. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 6: Caesarean section

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Bueno-Lopez 2018	9	59	19	60	46.5%	0.48 [0.24 , 0.98]
Desbriere 2013	21	110	19	110	53.5%	1.11 [0.63 , 1.94]
Total (95% CI)		**169**		**170**	**100.0%**	**0.75 [0.33 , 1.69]**
Total events:	30		38			

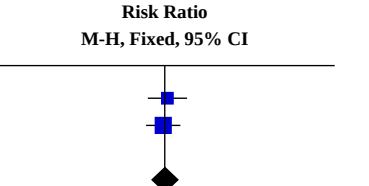
Heterogeneity: Tau² = 0.24; Chi² = 3.25, df = 1 (P = 0.07); I² = 69%
Test for overall effect: Z = 0.69 (P = 0.49)
Test for subgroup differences: Not applicable



Analysis 3.7. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 7: Instrumental vaginal birth

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bueno-Lopez 2018	15	59	14	60	39.8%	1.09 [0.58 , 2.05]
Desbriere 2013	20	110	21	110	60.2%	0.95 [0.55 , 1.65]
Total (95% CI)		**169**		**170**	**100.0%**	**1.01 [0.66 , 1.53]**
Total events:	35		35			

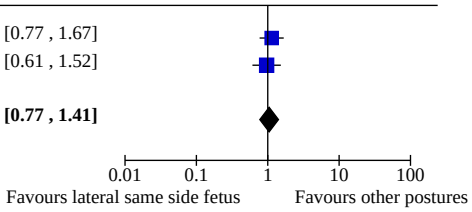
Heterogeneity: Chi² = 0.10, df = 1 (P = 0.75); I² = 0%
Test for overall effect: Z = 0.03 (P = 0.97)
Test for subgroup differences: Not applicable



Analysis 3.8. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 8: Episiotomy

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bueno-Lopez 2018	29	59	26	60	47.9%	1.13 [0.77 , 1.67]
Desbriere 2013	27	110	28	110	52.1%	0.96 [0.61 , 1.52]
Total (95% CI)		**169**		**170**	**100.0%**	**1.05 [0.77 , 1.41]**
Total events:	56		54			

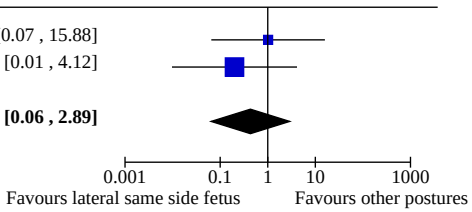
Heterogeneity: Chi² = 0.29, df = 1 (P = 0.59); I² = 0%
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



Analysis 3.9. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 9: Severe perineal tears (3rd degree or higher, as defined by trialists)

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bueno-Lopez 2018	1	59	1	60	28.4%	1.02 [0.07 , 15.88]
Desbriere 2013	0	110	2	110	71.6%	0.20 [0.01 , 4.12]
Total (95% CI)		**169**		**170**	**100.0%**	**0.43 [0.06 , 2.89]**
Total events:	1		3			

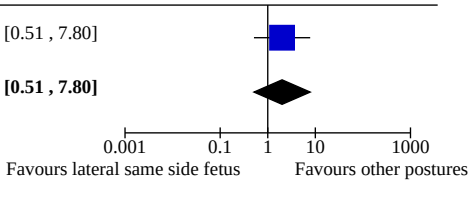
Heterogeneity: Chi² = 0.62, df = 1 (P = 0.43); I² = 0%
Test for overall effect: Z = 0.87 (P = 0.39)
Test for subgroup differences: Not applicable



Analysis 3.10. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 10: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists)

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	6	110	3	110	100.0%	2.00 [0.51 , 7.80]
Total (95% CI)		**110**		**110**	**100.0%**	**2.00 [0.51 , 7.80]**
Total events:	6		3			

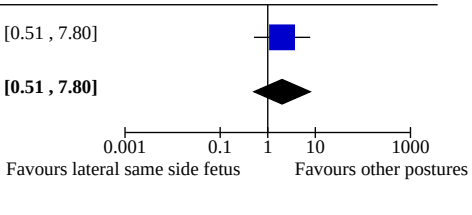
Heterogeneity: Not applicable
Test for overall effect: Z = 1.00 (P = 0.32)
Test for subgroup differences: Not applicable



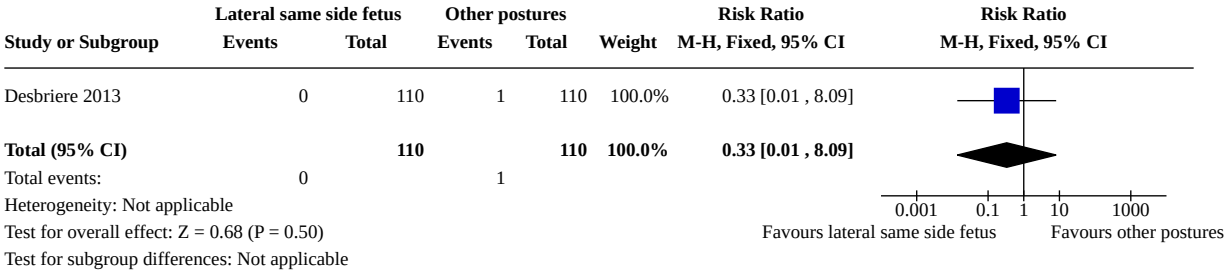
Analysis 3.11. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 11: Admission to neonatal intensive care

Study or Subgroup	Lateral same side fetus Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Desbriere 2013	6	110	3	110	100.0%	2.00 [0.51 , 7.80]
Total (95% CI)		**110**		**110**	**100.0%**	**2.00 [0.51 , 7.80]**
Total events:	6		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.00 (P = 0.32)
Test for subgroup differences: Not applicable



Analysis 3.12. Comparison 3: Lateral posture on same side as fetus versus other postures, Outcome 12: Birth trauma (as defined by trialists)



Comparison 4. Contralateral (opposite side to fetus) posture versus other postures

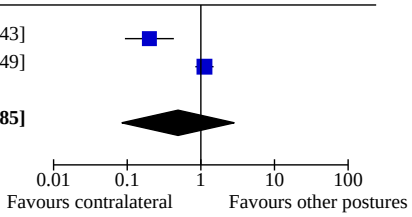
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.1 Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)	2	532	Risk Ratio (M-H, Random, 95% CI)	0.49 [0.08, 2.85]
4.2 Fetal malposition (OP/OT) after the intervention	2	525	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.20, 1.94]
4.3 Duration of labour	1	210	Mean Difference (IV, Fixed, 95% CI)	-0.76 [-1.14, -0.38]
4.4 Pain score (as defined by trialists using standardised tools)	1	322	Mean Difference (IV, Fixed, 95% CI)	0.10 [-0.28, 0.48]
4.5 Occipito-posterior/transverse position at birth	2	529	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.08, 2.89]
4.6 Caesarean section	2	532	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.17, 2.86]
4.7 Instrumental vaginal birth	2	532	Risk Ratio (M-H, Random, 95% CI)	0.43 [0.07, 2.76]
4.8 Episiotomy	1	270	Risk Ratio (M-H, Fixed, 95% CI)	0.79 [0.52, 1.20]
4.9 Severe perineal tears (3rd degree or higher, as defined by trialists)	1	270	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.15, 7.42]
4.10 Postpartum haemorrhage (as defined by trialists)	1	322	Risk Ratio (M-H, Fixed, 95% CI)	0.90 [0.48, 1.70]
4.11 Maternal satisfaction (as defined by trialists using standardised tools available)	1	322	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.87, 1.12]
4.12 Serious neonatal morbidity (composite outcome defined as death, admission	2	532	Risk Ratio (M-H, Fixed, 95% CI)	1.16 [0.43, 3.12]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
to neonatal intensive care, neonatal encephalopathy or as defined by trialists)				
4.13 Apgar scores less than seven at five minutes	1	322	Risk Ratio (M-H, Fixed, 95% CI)	0.25 [0.03, 2.24]
4.14 Admission to neonatal intensive care	1	322	Risk Ratio (M-H, Fixed, 95% CI)	1.16 [0.43, 3.12]

Analysis 4.1. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 1: Operative birth (composite outcome defined as caesarean section, instrumental vaginal birth)

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Random, 95% CI
Liu 2018	7	105	35	105	48.0%	0.20 [0.09 , 0.43]
Le Ray 2016	63	160	57	162	52.0%	1.12 [0.84 , 1.49]
Total (95% CI)		**265**		**267**	**100.0%**	**0.49 [0.08 , 2.85]**
Total events:	70		92			

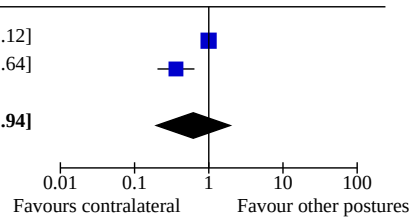
Heterogeneity: Tau² = 1.53; Chi² = 18.63, df = 1 (P < 0.0001); I² = 95%
Test for overall effect: Z = 0.79 (P = 0.43)
Test for subgroup differences: Not applicable



Analysis 4.2. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 2: Fetal malposition (OP/OT) after the intervention

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Random, 95% CI
Le Ray 2016	121	156	124	159	53.0%	0.99 [0.88 , 1.12]
Liu 2018	13	105	36	105	47.0%	0.36 [0.20 , 0.64]
Total (95% CI)		**261**		**264**	**100.0%**	**0.62 [0.20 , 1.94]**
Total events:	134		160			

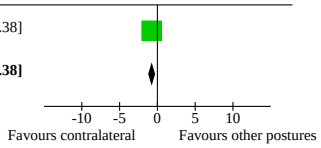
Heterogeneity: Tau² = 0.64; Chi² = 15.28, df = 1 (P < 0.0001); I² = 93%
Test for overall effect: Z = 0.83 (P = 0.41)
Test for subgroup differences: Not applicable



Analysis 4.3. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 3: Duration of labour

Study or Subgroup	Contralateral Mean [Hours]	Contralateral SD [Hours]	Contralateral Total	Other postures Mean [Hours]	Other postures SD [Hours]	Other postures Total	Weight	Mean Difference IV, Fixed, 95% CI [Hours]
Liu 2018	8.92	1.48	105	9.68	1.34	105	100.0%	-0.76 [-1.14 , -0.38]
Total (95% CI)			**105**			**105**	**100.0%**	**-0.76 [-1.14 , -0.38]**

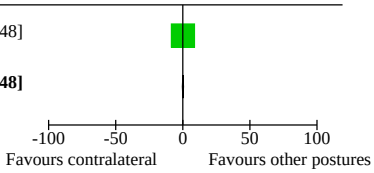
Heterogeneity: Not applicable
Test for overall effect: Z = 3.90 (P < 0.0001)
Test for subgroup differences: Not applicable



Analysis 4.4. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 4: Pain score (as defined by trialists using standardised tools)

Study or Subgroup	Contralateral Mean	SD	Total	Other postures Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Le Ray 2016	1.5	1.84	160	1.4	1.66	162	100.0%	0.10 [-0.28 , 0.48]
Total (95% CI)			**160**			**162**	**100.0%**	**0.10 [-0.28 , 0.48]**

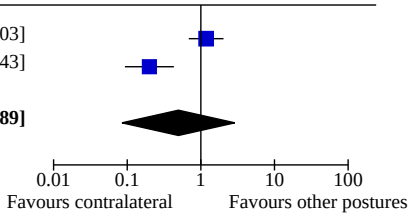
Heterogeneity: Not applicable
Test for overall effect: Z = 0.51 (P = 0.61)
Test for subgroup differences: Not applicable



Analysis 4.5. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 5: Occipito-posterior/transverse position at birth

Study or Subgroup	Contralateral Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Le Ray 2016	24	157	21	162	51.2%	1.18 [0.69 , 2.03]
Liu 2018	7	105	35	105	48.8%	0.20 [0.09 , 0.43]
Total (95% CI)		**262**		**267**	**100.0%**	**0.50 [0.08 , 2.89]**
Total events:	31		56			

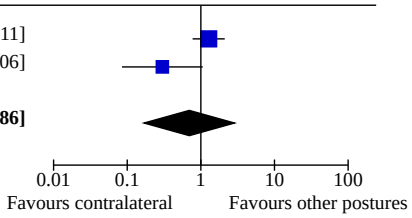
Heterogeneity: Tau² = 1.51; Chi² = 14.15, df = 1 (P = 0.0002); I² = 93%
Test for overall effect: Z = 0.78 (P = 0.44)
Test for subgroup differences: Not applicable



Analysis 4.6. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 6: Caesarean section

Study or Subgroup	Contralateral Events	Total	Other postures Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
Le Ray 2016	29	160	23	162	58.2%	1.28 [0.77 , 2.11]
Liu 2018	3	105	10	105	41.8%	0.30 [0.08 , 1.06]
Total (95% CI)		**265**		**267**	**100.0%**	**0.70 [0.17 , 2.86]**
Total events:	32		33			

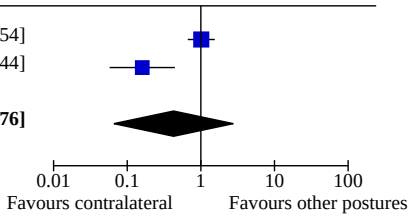
Heterogeneity: Tau² = 0.83; Chi² = 4.45, df = 1 (P = 0.03); I² = 78%
Test for overall effect: Z = 0.50 (P = 0.62)
Test for subgroup differences: Not applicable



Analysis 4.7. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 7: Instrumental vaginal birth

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Random, 95% CI
Le Ray 2016	34	160	34	162	53.1%	1.01 [0.66 , 1.54]
Liu 2018	4	105	25	105	46.9%	0.16 [0.06 , 0.44]
Total (95% CI)		**265**		**267**	**100.0%**	**0.43 [0.07 , 2.76]**
Total events:	38		59			

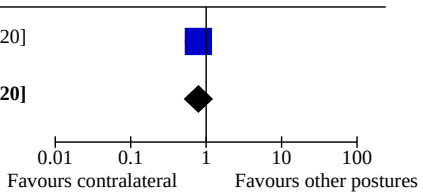
Heterogeneity: Tau² = 1.66; Chi² = 11.49, df = 1 (P = 0.0007); I² = 91%
Test for overall effect: Z = 0.90 (P = 0.37)
Test for subgroup differences: Not applicable



Analysis 4.8. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 8: Episiotomy

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	29	131	39	139	100.0%	0.79 [0.52 , 1.20]
Total (95% CI)		**131**		**139**	**100.0%**	**0.79 [0.52 , 1.20]**
Total events:	29		39			

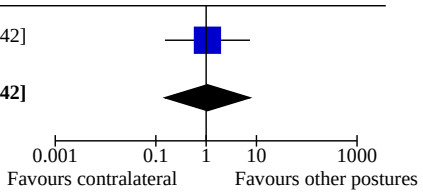
Heterogeneity: Not applicable
Test for overall effect: Z = 1.11 (P = 0.27)
Test for subgroup differences: Not applicable



Analysis 4.9. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 9: Severe perineal tears (3rd degree or higher, as defined by trialists)

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	2	131	2	139	100.0%	1.06 [0.15 , 7.42]
Total (95% CI)		**131**		**139**	**100.0%**	**1.06 [0.15 , 7.42]**
Total events:	2		2			

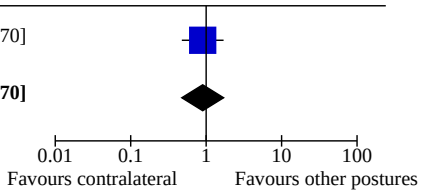
Heterogeneity: Not applicable
Test for overall effect: Z = 0.06 (P = 0.95)
Test for subgroup differences: Not applicable



Analysis 4.10. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 10: Postpartum haemorrhage (as defined by trialists)

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	16	160	18	162	100.0%	0.90 [0.48 , 1.70]
Total (95% CI)		**160**		**162**	**100.0%**	**0.90 [0.48 , 1.70]**
Total events:	16		18			

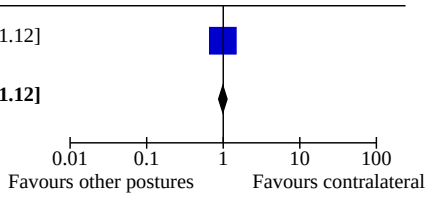
Heterogeneity: Not applicable
Test for overall effect: Z = 0.32 (P = 0.75)
Test for subgroup differences: Not applicable



Analysis 4.11. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 11: Maternal satisfaction (as defined by trialists using standardised tools available)

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	120	160	123	162	100.0%	0.99 [0.87 , 1.12]
Total (95% CI)		**160**		**162**	**100.0%**	**0.99 [0.87 , 1.12]**
Total events:	120		123			

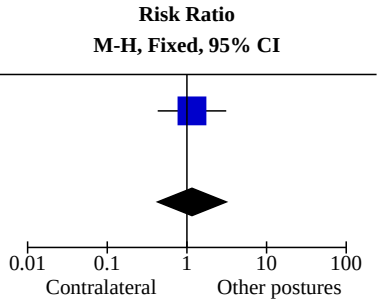
Heterogeneity: Not applicable
Test for overall effect: Z = 0.19 (P = 0.85)
Test for subgroup differences: Not applicable



Analysis 4.12. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 12: Serious neonatal morbidity (composite outcome defined as death, admission to neonatal intensive care, neonatal encephalopathy or as defined by trialists)

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	8	160	7	162	100.0%	1.16 [0.43 , 3.12]
Liu 2018	0	105	0	105		Not estimable
Total (95% CI)		**265**		**267**	**100.0%**	**1.16 [0.43 , 3.12]**
Total events:	8		7			

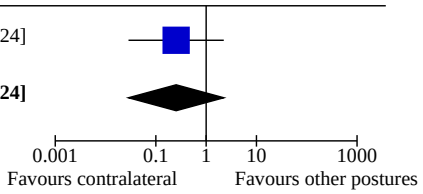
Heterogeneity: Not applicable
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



Analysis 4.13. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 13: Apgar scores less than seven at five minutes

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	1	160	4	162	100.0%	0.25 [0.03 , 2.24]
Total (95% CI)		**160**		**162**	**100.0%**	**0.25 [0.03 , 2.24]**
Total events:	1		4			

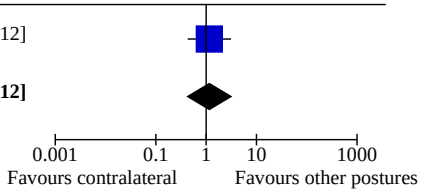
Heterogeneity: Not applicable
Test for overall effect: Z = 1.23 (P = 0.22)
Test for subgroup differences: Not applicable



Analysis 4.14. Comparison 4: Contralateral (opposite side to fetus) posture versus other postures, Outcome 14: Admission to neonatal intensive care

Study or Subgroup	Contralateral Events	Contralateral Total	Other postures Events	Other postures Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Le Ray 2016	8	160	7	162	100.0%	1.16 [0.43 , 3.12]
Total (95% CI)		**160**		**162**	**100.0%**	**1.16 [0.43 , 3.12]**
Total events:	8		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



APPENDICES

Appendix 1. ClinicalTrials.gov and ICTRP search methods

Each line was run separately and duplicates were removed manually.

ClinicalTrials.gov

Advanced search

occipito | Interventional studies | labor

occipito | Interventional studies | pregnancy

malposition | Interventional studies | labor

malposition | Interventional studies | pregnancy

malpresentation | Interventional studies | labor

malpresentation | Interventional studies | pregnancy

occipitoposterior

ICTRP

fetal AND occip*

foetal AND occip*

occipitoposterior

fetal AND malposition

foetal AND malposition

fetal AND malpresentation

foetal AND malpresentation

CONTRIBUTIONS OF AUTHORS

Jennifer Barrowclough wrote the first draft of the review proposal form with input from the co-authors. Jennifer wrote the first draft of the protocol, planned data analysis and GRADE tables. Bridget Kool, Justus Hofmeyr, and Caroline Crowther revised drafts of the protocol. All authors have approved the final version of the protocol submitted. Caroline Crowther is the guarantor of the review.

For this review, Jennifer Barrowclough (JB) and Caroline Crowther (CC) applied the selection criteria; all five authors (JB, Luling Lin (LL), Bridget Kool (BK), Justus Hofmeyr (JH), CC) assessed trustworthiness, extracted data for included studies, and assessed risk of bias. JB and LL carried out GRADE assessments and prepared summary of findings tables. JB wrote the first draft of the review and all five authors (JB, LL, BK, JH, CC) contributed to the drafts and editing of the review.

DECLARATIONS OF INTEREST

Jennifer Barrowclough: reports receiving a student scholarship from the Liggins Institute, University of Auckland, funds from Shundi Group Ltd, and funds from Work Force New Zealand education grant.

Caroline Crowther: has declared no conflict of interest.

Bridget Kool: has declared no conflict of interest

Luling Lin: has declared no conflict of interest.

Justus Hofmeyr: reports being an Associate Editor for Cochrane Pregnancy Childbirth, and reports no involvement in the editorial processing of this review. Reports receiving consulting fees and royalties unrelated to this topic.

SOURCES OF SUPPORT

Internal sources

- Shundi Group Ltd, New Zealand

  Scholarship and stipend for one year
- Liggins Institute, University of Auckland, New Zealand

  Scholarship
- Work Force New Zealand, New Zealand

  Postgraduate education grant
- University of Botswana, Botswana

  Salary support
- Faculty of Medical and Health Sciences, University of Auckland, New Zealand

  Salary support
- Liggins Institute, University of Auckland, New Zealand

  Salary support

External sources

- Australian and New Zealand Pregnancy and Childbirth Satellite, New Zealand

  Institutional support

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

The protocol for this review was published in PROSPERO - see www.crd.york.ac.uk/prospero/display_record.php?RecordID=214341. Any differences between our published protocol and the full review are listed below.

- We have incorporated the Cochrane Pregnancy and Childbirth Trustworthiness Screening Tool (CPC-TST).

NOTES

The original review 'Hands and knees posture in late pregnancy or labour for fetal malposition (lateral or posterior)' (Hunter 2007) has now been split into two reviews.

- Maternal postures for fetal malposition in labour for improving the health of mothers and their infants (this review).
- Maternal postures for fetal malposition in late pregnancy for improving the health of mothers and their infants (Hofmeyr review in progress).