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Techniques for managing an impacted fetal head at caesarean section: A systematic review

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ABSTRACT

A complication arising at caesarean birth when the baby's head is deeply engaged in the pelvis and may be difficult to deliver, is known as an 'impacted fetal head'. This obstetric emergency occurs in 16% of second stage caesarean sections. Multiple techniques are described in the literature to manage the complication but there is no consensus regarding which technique results in the best maternal and neonatal outcomes. The objective of this review is to determine which technique for managing impacted fetal head at caesarean section has the best maternal and neonatal outcomes.

A literature search of three electronic databases was conducted in November 2021. Studies directly comparing two methods for the management of impacted fetal head at caesarean section in the second stage were included. Systematic reviews, *meta*-analyses, case-control studies, and studies not fitting the search criteria were excluded. Data was extracted in Covidence and *meta*-analysis of the six most commonly reported outcomes was conducted using RevMan 5.4.

In total, 16 studies (3344women) were included. 13 studies (2506women) compared the push method with reverse breech extraction. meta-analysis showed that risk of extension of the uterine incision, blood transfusion, bladder injury, postpartum haemorrhage, NICU admission and Apgar score <7 at 5 min were significantly higher with the push method compared with reverse breech extraction. Three studies (838women) compared the push method with Patwardhan's technique. meta-analysis of studies comparing the push method with Patwardhan's technique found no significant differences between the two groups in any of the six maternal or neonatal outcomes.

Evidence derived from small, inadequately powered studies suggests reverse breech extraction is associated with better outcomes than the push method. The method which produces the best outcomes is still unknown as not all methods have been tested. Further high quality, adequately powered RCTs are warranted for definitive conclusions to be drawn and to ameliorate the paucity of evidence on how best to manage this complication.

Introduction

Impacted fetal head is a complication occurring at caesarean section which is most commonly observed following a failed instrumental delivery. The fetal head becomes fixed or 'impacted' in the woman's pelvis causing a lack of space between the bony pelvis, pelvic muscles and the fetal head (1). This can happen at any stage of labour but is most common in the second stage (2,3). The complication occurs in up to 5 % of all caesareans (4–7) and 16 % of second stage caesareans (8). Impacted fetal head carries a high risk of maternal and neonatal complications.

Many different techniques have been advocated for managing an impacted fetal head. Using gravity by lowering the head end of the operating table and maintaining it in this position for ten minutes is called the head down tilt method. Devices such as fetal pillow and Tydeman Tube have also been developed. The Fetal Pillow is a silicone balloon cephalic elevation device which is inserted beneath the fetal head, with the woman in the lithotomy position. The pillow is then and inflated with saline (1,9), elevating the fetal head three to four centimetres from its original position (1). The Tydeman Tube is a semi-rigid silicone tube with a hollow section in the middle and a soft cup at one end. Because the tube is hollow, air can move into the space surrounding the fetal head which helps to break the partial vacuum between the woman's pelvis and the fetal head caused by Ferguson reflexes (10). Tocolytic medications such as terbutaline (11), ritodrine (12) and

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Table 1
Characteristics of included studies – continued.

Author, year	Type of study	Country	Study setting	Techniques compared	Number of women in study
Bastani, 2012	Randomised control trial	Iran	Taleghani Women's Hospital – a single centre in Tabriz (city in Iran)	Push Reverse breech	59
Bhoi, 2019	Observational study	India	VSS Medical college and hospital, Burla, Odisha, India	Push Patwardhan	420
Chopra, 2009	Observational study	India	Nehru Hospital, Postgraduate Institute of Medical Education and Research, Chandigarh	Push Reverse breech	182
Ezra, 2020	Observational study	Israel	Department of obstetrics and gynaecology, JN medical college, Aligarh	Push Reverse breech	969
Fasubaa, 2002	Randomised control study	Nigeria	Obafemi Awolowo University Teaching Hospitals Complex – 2 obstetric units in Ile-Ife and Ilesha which are both semi-urban towns	Push Reverse breech	108
Frass, 2011	Case control study	Yemen	Obstetrics and Gynaecology Department, Al-Thawra General Hospital, Sana'a, Yemen	Push Reverse breech	118
Gil, 2019	Observational study	Israel	2 campuses of public university tertiary referral centre	Push Reverse breech	321
Kadhum, 2009	Randomised control study	Iraq	l-Zahraa Maternity and Paediatric Teaching Hospital in Al- Najaf	Push Reverse breech	50
Keepanasseril, 2019	Cohort study	India	Tertiary teaching hospital in South India – Women and Children's hospital attached to the Jawaharlal Institute of Medical Education and Research, Puducherry	Push Patwardhan	298
Lal, 2018	Observational study	India	Himalayan Institute of Medical Sciences – a tertiary care centre at Dehradun, Uttarakhand, India	Push Patwardhan	120
Lenz, 2019	Case control study	Switzerland	Tertiary care hospital in Zurich	Push Reverse breech	137
Levy, 2005	Observational study	Israel	Kaplan medical centre, Rehevot, Israel	Push Reverse breech	48
Nooh, 2017	Randomised control trial	Egypt	Al-Ahrar District General Hospital (DGH); Zagazig	Push Reverse breech	192
Tahir, 2020	Randomised control trial	Pakistan	Department of Obstetrics and Gynaecology Military Hospital, Rawalpindi Majority of the women live rurally with limited health care and literacy; a large number of them arrive at hospital already in advanced labour or with obstruction as a result	Push Reverse breech	110
Veisi, 2012	Observational study	Iran	Imam Reza Hospital, Kermanshah, Iran	Push Reverse breech	72
Ziyauddin, 2013	Observational study	India	Department of obstetrics and gynaecology, JN medical college, Aligarh	Push Reverse breech	140

nitroglycerin (13) have been used in caesareans to relax the womb, allowing for more manoeuvre room. This can minimise some of the complications that arise from impacted fetal head due to a lack of space in the uterine cavity. With the push method, the head is flexed and pushed upwards through the vagina by an assistant (14). In a reverse breech extraction, the surgeon reaches through the uterine incision and delivers the baby feet-first with gentle traction (15–17). Patwardhan's technique is a modification of the reverse breech method (18) whereby the shoulders of the baby are delivered first (1,19) followed by rotation of the head and delivery of the posterior shoulder and arm. Once the body is delivered, the head is lifted out of the pelvis (20,21).

Our aim was to conduct a systematic review of techniques for managing an impacted fetal head at caesarean section.

Material and methods

Data sources and study selection

A protocol was developed prior to data collection and was prospectively registered with PROSPERO (CRD42021284573). A literature search was carried out using Embase (1974 – November 2021), Ovid Medline (1946 – November 2021), and the Maternity and Infant Care Database (MIDIRS) (1971 – November 2021) for studies published up until November 1st 2021. A search strategy was developed as shown in Appendix C. Study selection was carried out using EndNote (22) for abstract screening and Covidence (23) for full-text screening. They were assessed individually by two authors (AP and EB).

Data extraction

Using a bespoke data extraction form (Fig. A1 – appendices), data was extracted from included studies using Covidence systematic review software (24). Details of included studies such as lead author contact details, study setting, and any relevant notes on the study, were also extracted for points of reference; this information is shown in Table 1. The population, inclusion and exclusion criteria of included studies are shown in Table 2. Data was extracted independently by AP and EB to avoid error and then compared for consensus in Covidence, any disagreements were resolved by discussion with a third reviewer KFW.

To meet the inclusion criteria, each study had to compare the outcomes from two different techniques for managing an impacted fetal head at caesarean section. The studies had to provide primary data and hence systematic and literature reviews were excluded but randomised controlled trials, case control studies, and prospective and retrospective cohort studies were included. No language restrictions or study setting restrictions were made and all papers were available in English.

Statistical analysis

Statistical analysis was performed using Review Manager 5.4. Data sets with an I^2 below 50 % were analysed using the Mantel-Haenszel method and a fixed-effect model. Any outcomes that had an I^2 over 50 % were analysed using a random effects model. Summaries of the intervention effects for each study were provided using risk ratios (for dichotomous outcomes) or standardised mean differences (for continuous outcomes). Forest plots were generated for each analysis with a risk ratio at a 95 % confidence interval. Both models produced a Chi^2 figure with a corresponding p-value and the random effects model also

Table 2
Population, inclusion and exclusion criteria of included studies.

Author, year	Population Description	Inclusion Criteria	Exclusion Criteria
Bastani, 2012	Women with prolonged obstructed labour with fully dilated cervix, arrest of descent for >1 h and obstructed labour at station +2	- Very low station of fetal head in the second - stage of delivery - Dystocia - Vertex presentation	- Multiple pregnancies - Fetal anomalies - Previous caesarean delivery - Premature delivery
Bhoi, 2019	Women undergoing caesarean sections in advanced labour with deeply impacted head	- Singleton pregnancies - Cephalic presentation	- Major fetal anomaly - Non-vertex presentation with labour - Pre-existing maternal disease - Pregnancy complications (eg. gestational diabetes or gestational hypertension)
Chopra, 2009	Women undergoing caesarean section in advanced labour with impacted fetal head	- Singleton pregnancies - Cephalic presentation - Fetal head deeply engaged in the pelvis - −7 cm dilatation and vertex at or below zero station	NA
Ezra,2020	Women undergoing caesarean section at the second stage of delivery	- Vertex presentation	- Gestational age <37+0 - Multiple gestation - Non-vertex presentation - Missing data on mode of extraction and uterine rupture
Fasubaa, 2002	Women with prolonged obstructed labour at term with live fetus undergoing caesarean section	NA	- Intrauterine fetal death - Congenital fetal anomaly - Multiple pregnancy - Ruptured uterus - Previous caesarean section - Fetal head >2 fingerbreadths palpable per abdomen
Frass, 2011	Women with obstructed labour requiring abdominal delivery	- Singleton pregnancies - Term pregnant women (depending on the last menstrual period or early first trimester ultrasonography) - Cephalic presentation - Obstructed labour - Women requiring abdominal delivery	- Multiple pregnancy - Non-cephalic presentation - Previous scar - Preterm labour
Gil, 2019	Women undergoing caesareans with fully dilated cervix and fetal head at level of ischial spine of below	- Singleton pregnancies - Fully dilated cervix - Fetal head at ischial spine or below	- Multiple pregnancies - Congenital fetal anomalies - Preterm deliveries (<37 weeks) - Cases in which an inverted T uterine incision was performed - Cases with missing information Cases where both delivery methods were used - Fetal head above the ischial spines
Kadhum, 2009	Women submitted for emergency caesarean section with deeply engaged fetal head	- Singleton pregnancies - 2nd stage - At least 1 h fully dilated cervix - Deeply engaged head - Transverse uterine incision	NA
Keepanasseril, 2019	Women who underwent caesarean at full dilation	- Fetal head station at ischial spine or below - Push method - Patwardhan's	- Multiple pregnancies Non-vertex presentation - Delivery by pull method
Lal, 2018	Women undergoing caesarean for impacted fetal head	NA	- Intrauterine fetal death - Congenital fetal abnormality - Multiple pregnancy - Preterm caesarean section - Previous caesarean section
Lenz, 2019	Women at term required an intrapartum caesarean section	- At term - Singleton pregnancies - Cephalic presentation - Cervical dilation >/= 7 cm	- Multiple pregnancies - Fetal anomalies - Preterm delivery - Fetal presentation other than cephalic
Levy, 2005	Women undergoing non-elective caesarean deliveries	- Cases with documented difficult extraction of a singleton, term fetus in vertex presentation, during non-elective Caesarean deliveries	NA

(continued on next page)

Table 2 (*continued*)

Author, year	Population Description	Inclusion Criteria	Exclusion Criteria
Nooh, 2017	Women with obstructed labour, and requiring abdominal delivery	- Singleton pregnancies - At term (37–42 weeks) - Cephalic presentation - Second stage of labour for 2 h (multipara) or 3 h (primipara) - obstructed labour	- Multiple pregnancy - Preterm labour (<37 weeks gestation) - Non-cephalic presentation - Previous uterine scar
Tahir, 2020	Women undergoing caesarean due to obstructed labour, requiring abdominal delivery	- Singleton pregnancy - Cephalic presentation - >37 weeks of gestation	- Multiple pregnancies - Non-cephalic presentation - Previous caesarean section scar - Preterm labour
Veisi, 2012	Pregnant women with obstructed dystocia with impacted fetal head at full dilation leading to caesarean delivery via push or pull methods following a failed attempt at operative vaginal delivery by forceps application or vacuum extraction.	- Singleton pregnancy at 37 to 42 weeks - Cephalic presentation - Reactive fetal heart rate pattern	- Estimated fetal weight >4000 g - Intrauterine fetal death - Multiple pregnancy - Previous caesarean or myomectomy - Chorioamnionitis - Third-trimester haemorrhage
Ziyauddin, 2013	Women needing a caesarean section with an impacted fetal head	- Singleton pregnancy - Cephalic presentation - Term-pregnancy - Late stage of labour with >/= 7 cm - Vertex at or below 0 station	NA

calculated Tau^2. The significance of each result was determined by an overall p-value < 0.05.

All studies were assessed for bias. The ROBINS-I (25) tool was used for cohort studies and the Cochrane risk of bias tool (26) was used to assess randomised controlled trials. Descriptive statistics that were commonly reported such as operative time, duration of hospital stay, maternal blood loss and fetal birth weight were analysed graphically using mean values and compared across the various methods.

Results

The PRISMA flow diagram for this study is shown in Fig. 1. We identified 155 studies in our search. 100 remained after removal of duplicates. All 100 studies were English language. Following screening of titles and abstracts, 18 studies were excluded. For the remaining 82 studies, full texts were examined against the inclusion criteria, leaving 16 studies to be analysed. Papers were excluded for reasons such as lack of data. Table 1 gives the study characteristics for the 16 included studies.

Thirteen studies compared the push method and reverse breech extraction, and three studies compared the push method with Patwardhan's technique. The majority (11) of the included studies were observational. All three studies comparing the push method with Patwardhan's technique were observational and all randomised studies compared the push method with reverse breech extraction.

Clinical heterogeneity was examined in Tables 1 and 2 using outcomes, study characteristics, inclusion and exclusion criteria, and study setting. Risk of bias is presented in Figs. 2 and 3.

Primary outcome measure – Extension of the uterine incision

The push method showed a significantly higher risk of uterine incision extension, compared with reverse breech extraction [RR 3.0, 95 % CI 2.1–4.2, P < 0.00001; 12 studies; 2366 women; Fig. 4]. The push method showed no significant difference in risk of extension of the uterine incision compared with Patwardhan's technique [RR 4.5, 95 % CI 0.46–45, P = 0.20; 3 studies; 838 women; Fig. 4].

Secondary outcome measures – Maternal

Blood transfusions

For studies where intra and post-operative blood transfusions were reported separately, the data was combined to produce a total number of blood transfusion events. The push method showed a significantly higher risk of blood transfusion, compared with reverse breech extraction [RR 1.9, 95 % CI 1.4–2.5, P < 0.00001; 9 studies; 2079 women; Fig. 5]. The push method showed no significant difference in the risk of blood transfusions compared with Patwardhan's technique [RR 1.7, 95 % CI 0.7–4.0, P = 0.26; 3 studies; 838 women; Fig. 5].

Postpartum haemorrhage

For studies where atonic and traumatic PPH were reported separately, the data was combined to produce a number for the total events of PPH. Ezra 2020 (12) specified that the medical team set their own definition. Gill 2019 (28) defined PPH as >1000 ml blood loss. Keepanasseril 2019 (29) defined PPH as >1500 ml blood loss. The push method showed a significantly higher risk of PPH, compared with reverse breech extraction [RR 2.2, 95 % CI 1.7–3.0, P < 0.00001; 6 studies; 1790 women; Fig. 6]. The push method showed no significant difference in risk of PPH compared with Patwardhan's technique [RR 2.1, 95 % CI 0.6–7.3, P = 0.25; 2 studies; 418 women; Fig. 6].

Bladder injury

The push method showed a significantly higher risk of bladder injury, compared with reverse breech extraction [RR 1.9, 95 % CI 1.1–3.3, P = 0.02; 5 studies; 1672 women; Fig. 7]. The push method showed no significant difference in risk of bladder injury compared with Patwardhan's technique [RR 4.4, 95 % CI 0.57–34, P = 0.15; 2 studies; 418 women; Fig. 7].

Secondary outcome measures – Neonatal

NICU admission

The push method showed a significantly higher risk of NICU admission, compared with reverse breech extraction [RR 1.8, 95 % CI 1.4–2.5, P < 0.0001; 8 studies; 1967 babies; Fig. 8]. The push method showed no significant difference in risk of NICU admission compared with Patwardhan's technique [RR 0.92, 95 % CI 0.5–1.6, P = 0.78; 3 studies; 838 babies; Fig. 8].

Apgar score

The push method showed a significantly higher risk of Apgar score

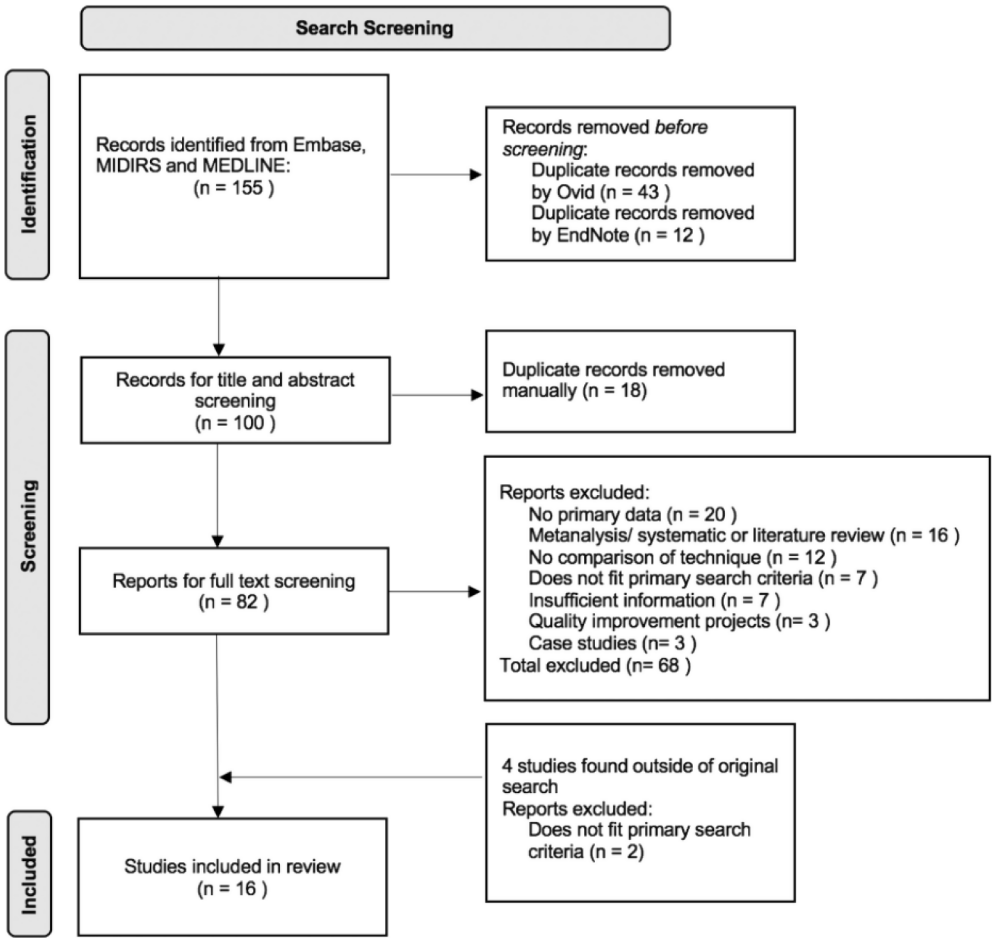

Fig. 1. PRIMSA flow diagram.

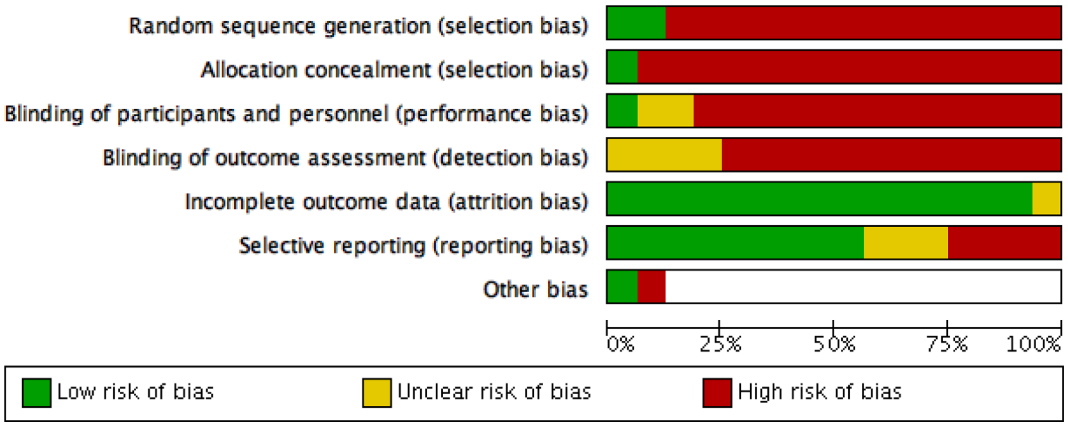

Fig. 2. Risk of bias graph generated from Review Manager 5.4 (27) – judgements about each risk of bias item presented as percentages across all included studies.

<7 at 5 min, compared with reverse breech extraction minutes [RR 1.5, 95 % CI 1.0–2.3, P = 0.04; 6 studies; 1648 babies; Fig. 9].

No studies which compared the push method with Patwardhan's technique reported Apgar score <7 at 5 min however, Apgar score <3 at 5 min was reported in one study and the push method showed no significant difference in risk of Apgar score <3 at 5 min compared with Patwardhan's technique [RR 1.7, 95 % CI 0.87–3.3, P = 0.12; 1 study; 420 babies; Fig. 10].

Discussion

Main findings

Reverse breech extraction was associated with significantly lower risk of extension of the uterine incision, need for blood transfusion, bladder injury, postpartum haemorrhage, NICU admission and Apgar score <7 at 5 min, when compared with the push method. On the other hand, there was no significant difference in risk of extension of the uterine incision, blood transfusions, bladder injury, postpartum

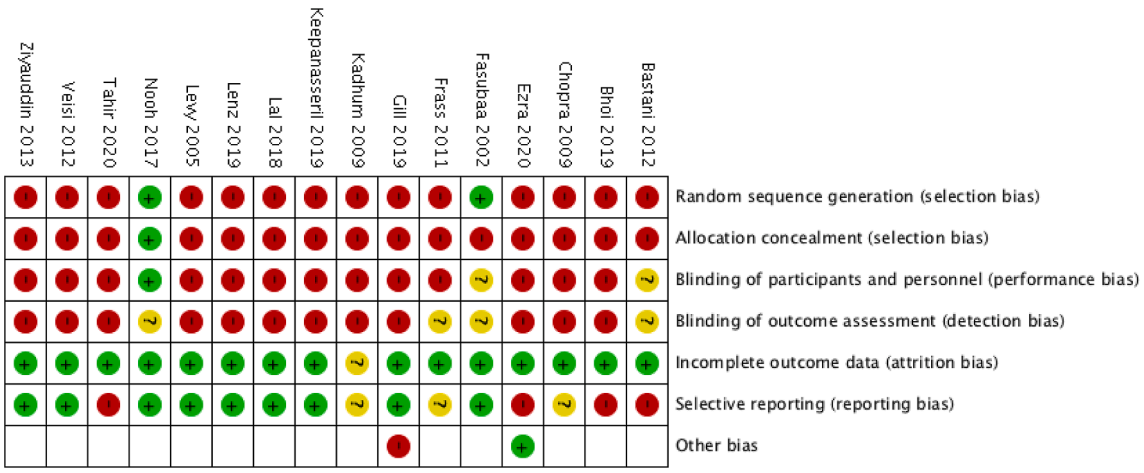

Fig. 3. Risk of bias summary generated from Review Manager 5.4 (27) – review authors' judgements about each risk of bias item for each included study.

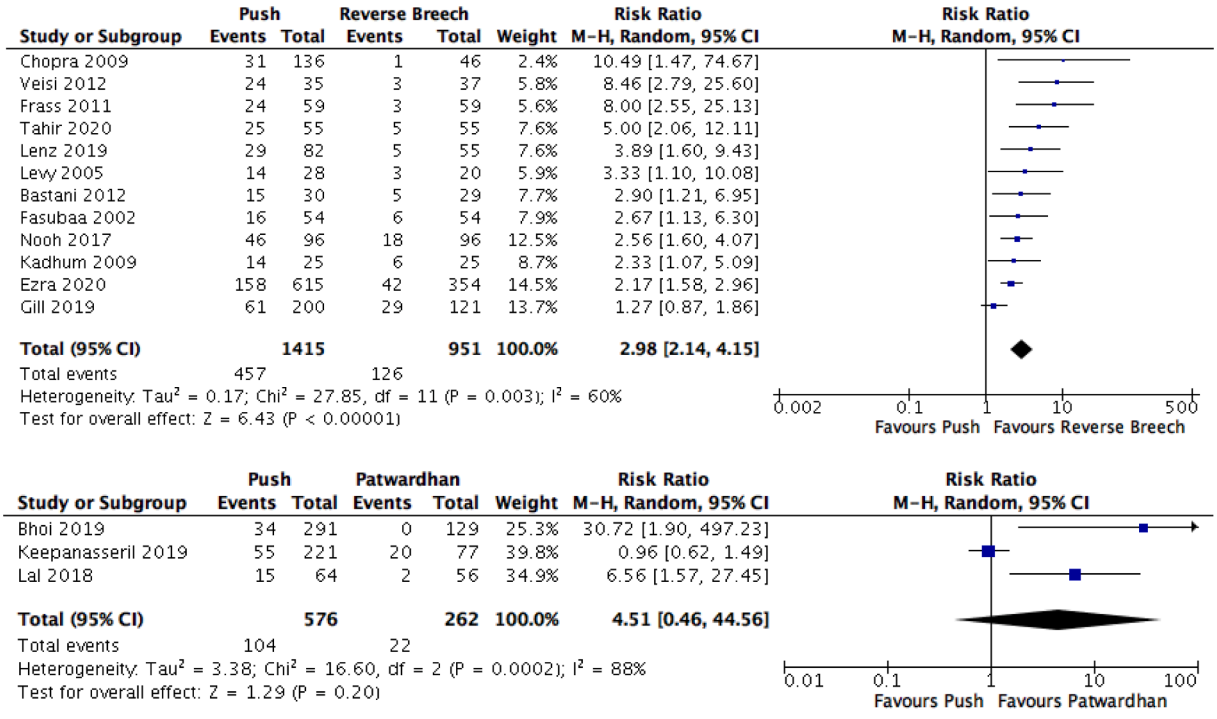

Fig. 4. Extension of the uterine incision.

haemorrhage and NICU admission, when the push method was compared with Patwardhan's technique.

Strengths and limitations

Impacted fetal head is difficult to define and so participant selection is at the discretion of the authors of each study. Clinical heterogeneity of the included studies was however, assessed thoroughly. This provided assurance that that the included studies were of similar setting, and were defined by very similar populations, inclusion and exclusion criteria, making them suitable for *meta*-analysis.

Most of the studies included in this systematic review are observational and so at high risk of bias; caution must therefore be applied when interpreting the results. There were only five RCTs in this review (including a total of 519 women), all of which compared the push method to reverse breech extraction. No RCTs for other methods to manage an impacted fetal head fitted the search criteria for this review, highlighting the paucity of randomised trial data for other, less-commonly used techniques. The observational studies in this review certainly suggest that reverse breech extraction is safer than the push method, but this must be tested in randomised trials.

The studies in this review included a mean population of 213 women however, the smallest studies included only 50 (Kadhum 2009 (30)) and 48 (and Levy 2005 (31)) women. When data from these studies was removed from the *meta*-analysis, the results for all three outcomes remained significant. The included studies in this review were from a diverse number of geographical locations with potential variation in healthcare services and availability. Other limitations for consideration include how the need for blood transfusion as an outcome measure could be influenced by the availability and local policy on giving blood products and is likely to vary in different settings, therefore differences observed between the different studies could be impacted by resource availability rather than a true difference in PPH.

Another limitation of the included studies in this study is the

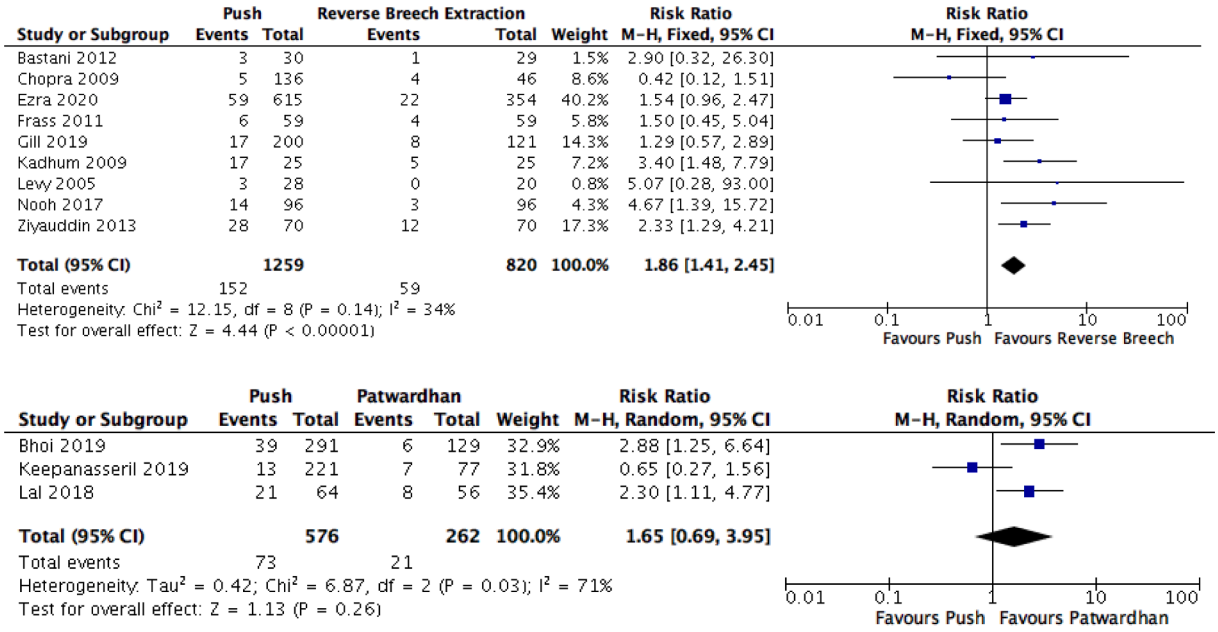

Fig. 5. Blood transfusion.

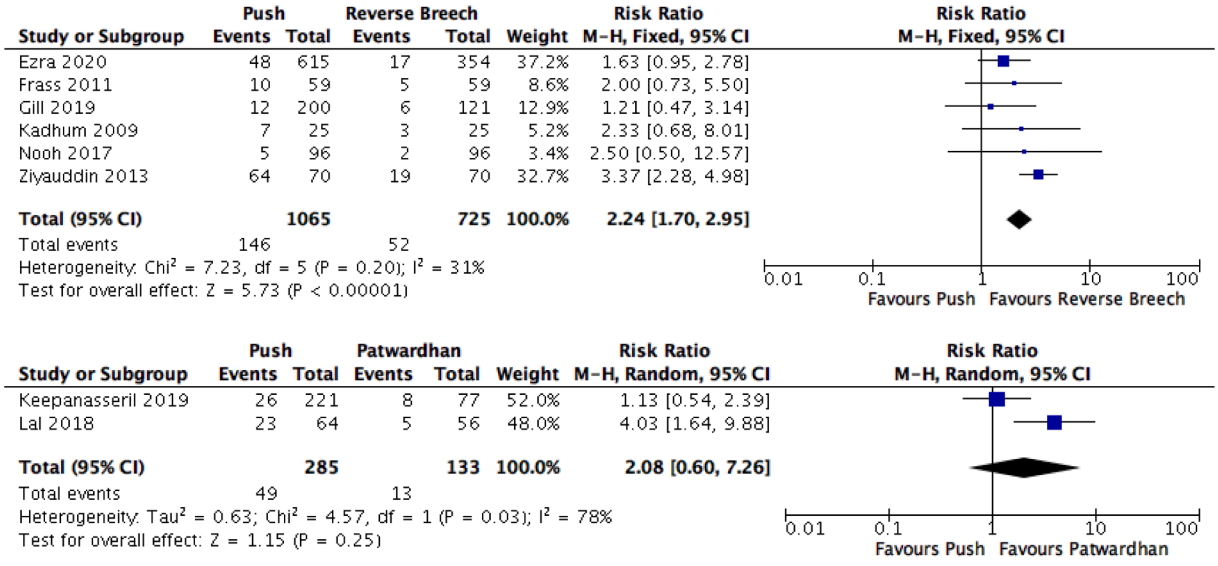

Fig. 6. Postpartum haemorrhage.

discrepancy in defining PPH. The lack of detail on the length of, and indication for NICU admissions is a further limitation.

Our study drew similar conclusions to a 2016 systematic review (32) and a 2020 literature review (33).

Meaning of the study

It has been postulated that reverse breech extraction produces better neonatal outcomes than the push method because there is less risk of injury to the fetus during delivery (34). Reverse breech extraction was also associated with reduced rates of uterine incision extension and postpartum haemorrhage. A similar association may exist between larger babies and increased incidence of extension of the uterine incision. However, there was little difference between the average birth weights of babies in the push group and reverse breech extraction, but extension of the uterine incision occurred significantly less with reverse breech extraction, so this possible explanation is not corroborated by our results. This review does not provide explanations as to why one technique may produce better outcomes than another. Evidence that one method produces better outcomes without explanation is nonetheless useful with regards to designing randomised trials in this area.

Unanswered questions for future research

Only three techniques were included in this systematic review which highlights the paucity of RCTs and observational studies for other methods used to manage an impacted fetal head. The question of which method produces the best maternal and neonatal outcomes still remains.

For additional meaningful conclusions to be drawn and for these to be implemented in clinical practice, further RCTs will need to be conducted comparing other techniques not included in this review, with reverse breech extraction, the push method and Patwardhan's technique. Moreover, if these techniques are to be safely implemented in practice, clinicians will require further training in the management of

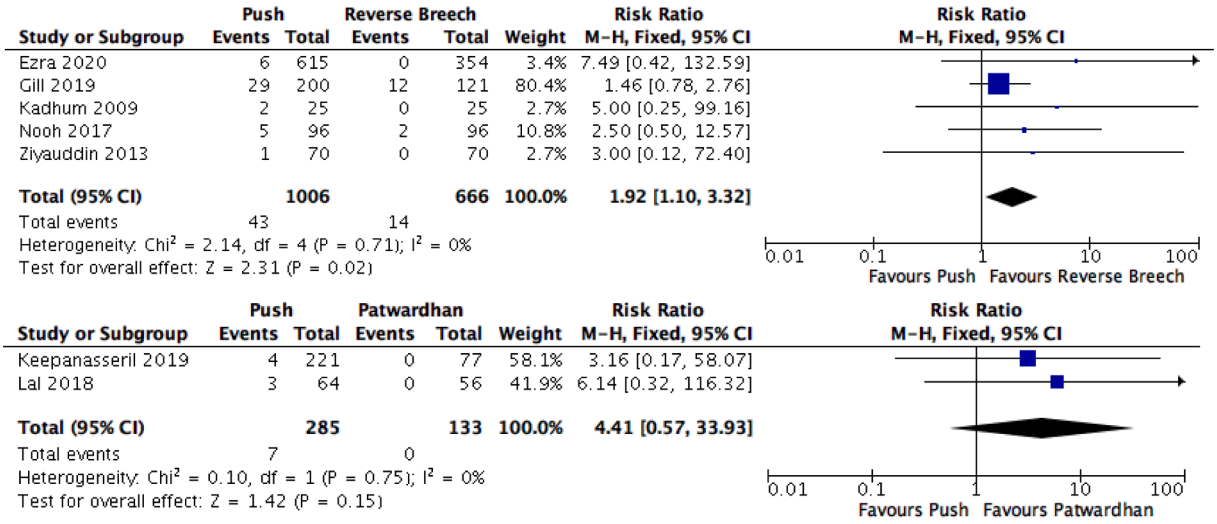

Fig. 7. Bladder injury.

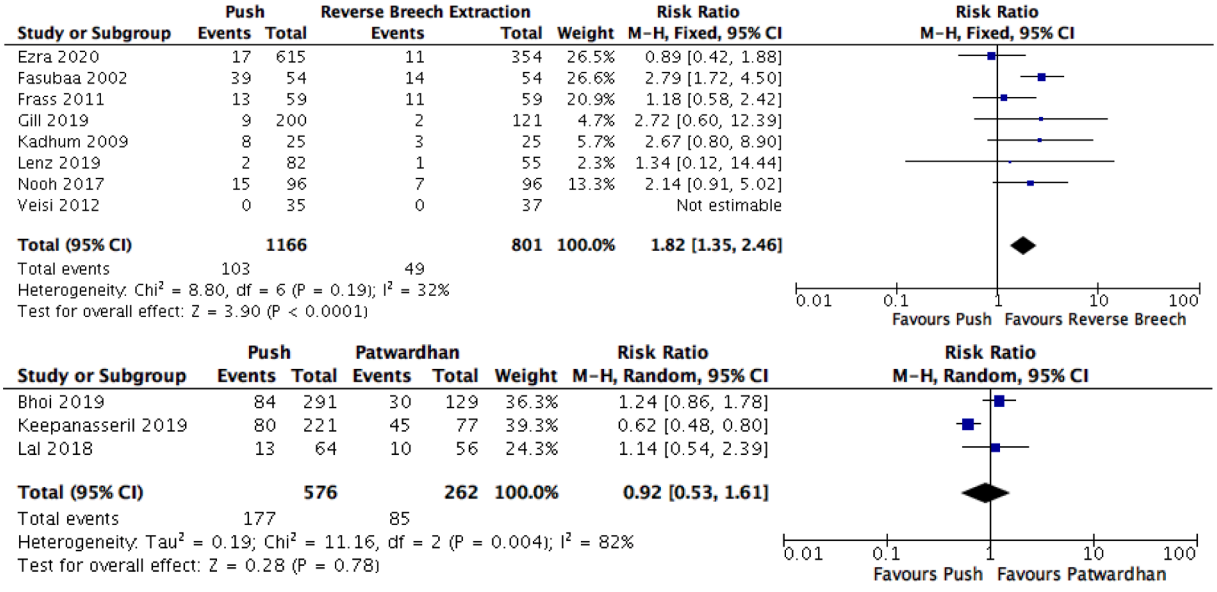

Fig. 8. NICU admissions.

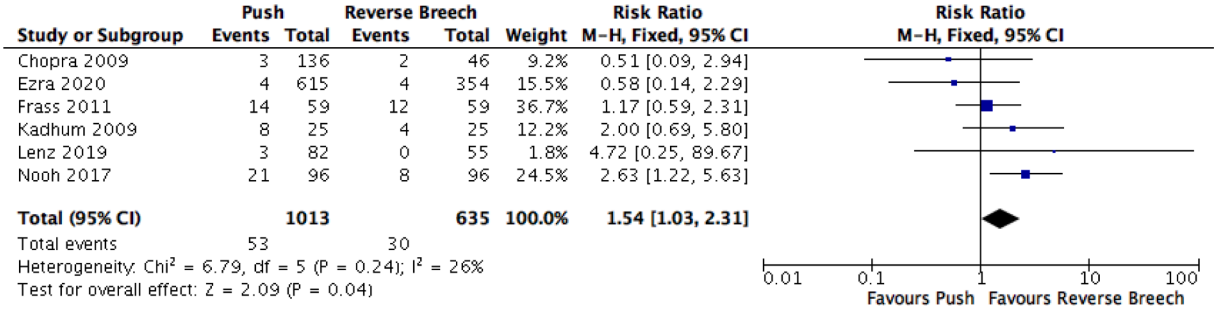

Fig. 9. Apgar score <7 at 5 min.

impacted fetal heads. Education on other methods and on selecting an appropriate technique for individual cases is required if the results of our study are to be implemented in clinical practice.

None of the included studies examined longer term neonatal complications following a caesarean complicated by an impacted fetal head. The wider literature on long-term complications is scarce.

Conclusions

This systematic review suggests reverse breech extraction is

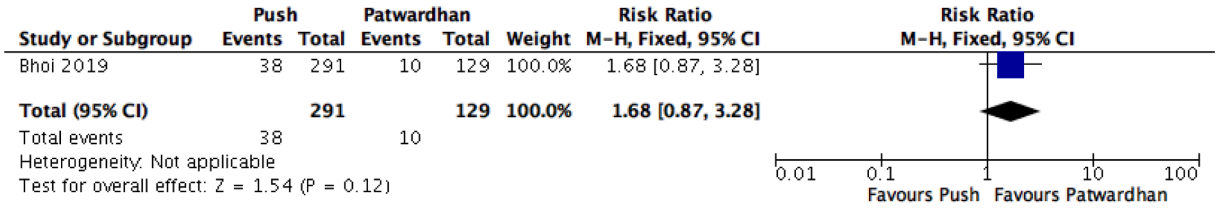

Fig. 10. Apgar score <3 at 5 min.

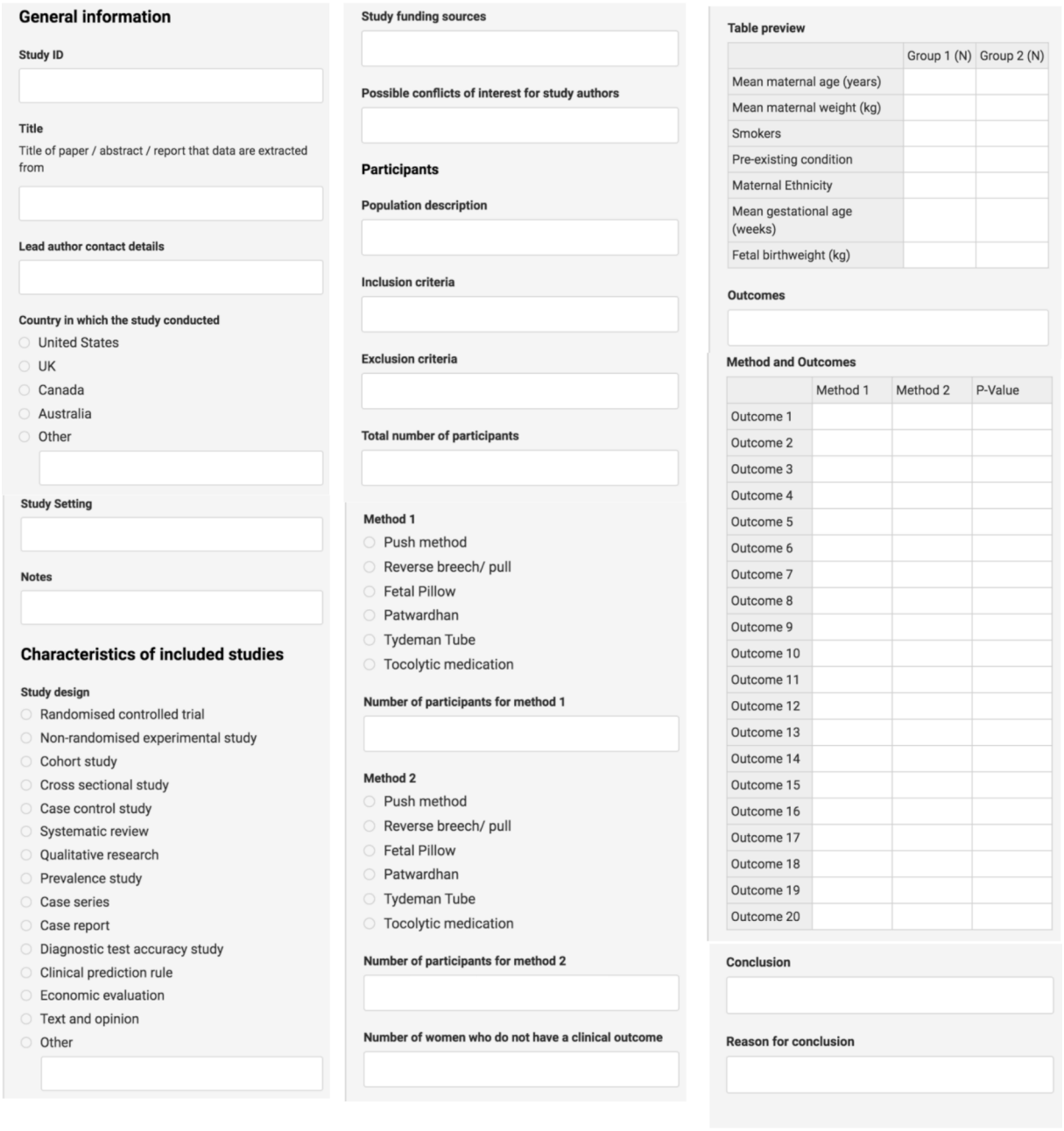

Fig. A1. Data extraction form – designed in Covidence (24).

associated with fewer adverse maternal and neonatal outcomes than the push method. The question of which method is the best still remains as not all techniques for impacted fetal heads were included in the studies analysed in this review; it also remains unclear whether the sequential use of techniques would produce fewer complications. The exponential increase in the number of studies investigating this since the 2016 Cochrane Review (19) highlights the importance of continued research on this topic. Further high quality, adequately powered RCTs and systematic reviews are warranted in order for definitive conclusions to be drawn.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

KFW has received a personal fellowship from the University of Nottingham which funds her time for this review.

Appendix A

Fig. A1.

B. PROSPERO registration form.

https://www.crd.york.ac.uk/prospero/display_record.php?ID = CRD42021284573

C. Ovid search strategy.

Term number	Search term	Number of results
1	caesarean OR caesarian OR Caesarean OR cesarian	229,991
2	section	539,271
3	1 AND 2	204,245
4	impacted f**tal head or deeply engaged head	145
5	deeply engaged f**tal head or impacted head	83
6	4 OR 5	192
7	3 AND 6	155
8	remove duplicates from 7	112

References:

[1] Jeve YB, Navti OB, Konje JC. Comparison of techniques used to deliver a deeply impacted fetal head at full dilation: a systematic review and meta-analysis. BJOG 2016;123(3):337–45.
[2] Cornthwaite K, Draycott T, Bahl R, Hotton E, Winter C, Lenguerrand E. Impacted fetal head: A retrospective cohort study of emergency caesarean section. Eur J Obstet Gynecol Reprod Biol 2021;261:85–91.
[3] Cornthwaite K, Bahl R, Lenguerrand E, Winter C, Draycott T. Impacted fetal head at cesarean section: National survey of practice. J Obstet Gynaecol Res 2020;46 (SUPPL 1):47–8.
[4] Loudon JA, Groom KM, Hinkson L, Harrington D, Paterson-Brown S. Changing trends in operative delivery performed at full dilatation over a 10-year period. J Obstet Gynaecol 2010;30(4):370–5.
[5] Unterscheider J, McMenamin M, Cullinane F. Rising rates of caesarean deliveries at full cervical dilatation: a concerning trend. Eur J Obstet Gynecol Reprod Biol 2011; 157(2):141–4.
[6] Corry EMA, Ramphul M, Rowan AM, Segurado R, Mahony RM, Keane DP. Exploring full cervical dilatation caesarean sections-A retrospective cohort study. Eur J Obstet Gynecol Reprod Biol 2018;224:188–91.
[7] Digital N. NHS Maternity Statistics, England 2019–20. digital.nhs.uk: NHS; 2020. Contract No.: October 18.
[8] Wyn Jones Nia, Mitchell Eleanor J, Wakefield Natalie, Knight Marian, Dorling Jon, Thornton Jim G, et al. Walker Impacted fetal head during second stage Caesarean birth: A prospective observational study. European Journal of Obstetrics & Gynecology and Reproductive Biology 2022;272:77–81.
[9] Singh M, Varma R, New developments.. Reducing complications associated with a deeply engaged head at caesarean section: a simple instrument. Obstetrician and Gynaecologist 2008;10(1):38–41.
[10] Birth (Parturition). Contract No.: September 27.
[11] Ph.D DRW. Terbutaline for preterm labor 2017 [Available from: https://www.healthline.com/health/pregnancy/preterm-labor-terbutaline.
[12] Ezra Y, Wade C, Rolbin SH, Farine D. Uterine tocolysis at cesarean breech delivery with epidural anesthesia. J Reprod Med 2002;47(7):555–8.
[13] Morgan PJ, Kung R, Tarshis J. Nitroglycerin as a uterine relaxant: a systematic review. J Obstet Gynaecol Can 2002;24(5):403–9.
[14] Landesman R, Graber EA. Abdominovaginal delivery: modification of the cesarean section operation to facilitate delivery of the impacted head. Am J Obstet Gynecol 1984;148(6):707–10.
[15] Blickstein I. Difficult delivery of the impacted fetal head during cesarean section: Intraoperative disengagement dystocia. J Perinat Med 2004;32(6):465–9.
[16] Fong YF, Arulkumaran S. Breech extraction–an alternative method of delivering a deeply engaged head at cesarean section. Int J Gynaecol Obstet 1997;56(2):183–4.
[17] Hassanien T. A new indication for breech extraction. Aust N Z J Obstet Gynaecol 1999;39(4):509–10.
[18] Sethuram R, Jamjute P, Kevelighan E. Delivery of the deeply engaged head: a lacuna in training. J Obstet Gynaecol 2010;30(6):545–9.
[19] Waterfall H, Grivell RM, Dodd JM. Techniques for assisting difficult delivery at caesarean section (Cochrane Review). The. Cochrane Database Syst Rev 2016. Assessed as up-to-date: 30 September 2015.
[20] Chavan PN. Difficult extraction of the fetus presented in aicog 09.01.19 2019 [Available from: https://www.slideshare.net/DrNiranjanChavan/difficult-extraction-of-the-fetus-presented-in-aicog-090119.
[21] Saha PK, Gulati R, Goel P, Tandon R, Huria A. Second stage caesarean section: evaluation of patwardhan technique. J Clin Diagn Res 2014;8(1):93–5.
[22] The EndNote Team. EndNote. EndNote X9 ed. Philadelphia, PA: Clarivate; 2013.
[23] Covidence systematic review softwarre Melbourne, Australia: Veritas Health Innovation; 2021 [Available from: http://www.covidence.org/.
[24] Covidence - Veritas Health Innovation, Melbourne, Australia. . www.covidence.org.
[25] Sterne J, Hernán M, Reeves B, Savović J, Berkman N, Viswanathan M, et al. ROBINS-I: a tool for assessing risk of ias in non-randomised studies of interventions. BMJ 2016;355(4919).
[26] Higgins JPT, Altman DG, Gotzsche PC, Juni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ 2011;343(oct18 2):d5928–.
[27] TheCochraneCollaboration.. Review Manager (RevMan) [Computer program]. Version 2020, 2020.;5(4):pp.
[28] Gil Moran, Chill Henry H, Kogan Liron, Porat Shay, Levitt Lorinne, Eliasi Elior, et al. Preferred way of delivery of the impacted fetal head in cesarean sections during second stage of labor. J Obstet Gynaecol Res 2019;45(12):2386–93.
[29] Keepanasseril A, Shaik N, Kubera NS, Adhisivam B, Maurya DK. Comparison of 'push method' with 'Patwardhan's method' on maternal and perinatal outcomes in women undergoing caesarean section in second stage. J Obstet Gynaecol 2019;39 (5):606–11.
[30] Kadhum J. Head pushing versus reverse breech extraction for delivery of impacted fetal head during caesarean section. Kufa MedJournal 2009;2009.
[31] Levy Roni, Chernomoretz Tamara, Appelman Zvi, Levin Dan, Or Yuval, Hagay Zion J. Head pushing versus reverse breech extraction in cases of impacted fetal head during Cesarean section. European Journal of Obstetrics and Gynecology and Reproductive Biology 2005;121(1):24–6.
[32] Jeve YB, Navti OB, Konje JC. Comparison of techniques used to deliver a deeply impacted fetal head at full dilation: A systematic review and meta-analysis. BJOG 2016;123(3):337–45.
[33] Markin LB, Rachkevych OS, Zhemela OM. Reverse breech extraction at cesarean section in second stage of labor. Wiadomosci lekarskie (Warsaw, Poland : 1960). 2020;73(5):1028-31.
[34] Fasubaa OB, Ezechi OC, Orji EO, et al. Delivery of the impacted head of the fetus at caesarean section after prolonged obstructed labour: a randomised comparative study of two methods. J Obstet Gynaecol 2002;22(4):375–8.

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