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Forceps delivery for non-rotational and rotational operative vaginal delivery

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A B S T R A C T

Forceps are a commonly used instrument for assisting vaginal birth. Accepted indications include prolonged labour, suspected foetal distress and maternal medical conditions that benefit from a shortened second stage of labour. Maternal and offspring outcomes of forceps-assisted birth have been extensively reported in observational studies, but randomised trial evidence is limited. Forceps-assisted delivery has a lower failure rate than vacuum-assisted delivery but is associated with a higher incidence of maternal pelvic floor trauma. Second-stage caesarean section is associated with less foetal-neonatal trauma than forceps-assisted delivery but markedly reduces the chance of a subsequent vaginal birth. This review outlines the existing evidence on prevention, indications and contraindications for forceps-assisted birth (non-rotational and rotational), short- and long-term complications for mother and baby, alternatives to use of forceps and how to manage an abandoned forceps-assisted birth. The essential components of informed consent are also discussed.

Background

Obstetric forceps are used to expedite vaginal birth where prompt delivery is believed to be in the interests of the mother or foetus. The incidence of operative vaginal delivery (OVD) is 10–15% in the United Kingdom, and over half of these procedures are performed by forceps [1,2]. There is marked

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variation at the regional level as well as varying individual operator preference. Forceps are generally readily available in low-, middle- and high-income labour ward settings and may be used safely by doctors who have received appropriate training and in some settings by midwives [3]. The time taken to complete a forceps-assisted birth is similar to that of a ventouse, but when the procedure can be completed in a labour room, it takes on average half the time required to complete a caesarean section in an operating theatre (15 min versus 30 min) [4]. Informed consent from the woman is required prior to conducting a forceps-assisted birth, aided by antenatal provision of information about the relative advantages and disadvantages of assisted vaginal birth for all pregnant women [5].

Practice-based guidelines are helpful in supporting clinical care, as most of the procedural aspects of forceps-assisted delivery are based on expert opinion rather than robust research evidence. The classification of forceps delivery was first outlined in the guidelines of the American College of Obstetricians and Gynecologists (ACOG), and this was adapted by the Royal College of Obstetricians and Gynaecologists (RCOG) [5,6]. Forceps-assisted deliveries are classified in the US by the station of the foetal head at application (in relation to the maternal ischial spines) and the degree of rotation necessary for delivery (Table 1). Early studies have demonstrated that the lower the station of the foetal head and the less rotation required, the lower is the incidence of maternal and foetal injury during forceps-assisted birth [7,8].

Indications

Accepted indications for forceps delivery in high-income settings are threefold: lack of progress; suspected foetal distress and maternal conditions, where it is considered beneficial to shorten the second stage of labour [5,6,9–11]. Although controversial, forceps may be indicated following a failed or abandoned attempt at ventouse-assisted delivery, where the head is on the pelvic floor. Each of these indications will be discussed in turn.

Prolonged second stage

A lack of progress in labour may reflect inadequate contractions, a macrosomic foetus relative to the maternal pelvic dimensions or a malposition (occipito-transverse OT and occipito-posterior OP) resulting in relative cephalopelvic disproportion (CPD). Defining inadequate progress in the second stage of labour depends on the setting and the woman. In Canada and the UK, national guidance defines this as nulliparous women who lack continuing progress for 3 h (total of active and passive second stage of labour) with regional anaesthesia, or 2 h without regional anaesthesia; multiparous women who lack continuing progress for 2 h (total of active and passive second-stage labour) with regional anaesthesia, or 1 h without regional anaesthesia [6,9]. In the US, recent population-based cohort evidence on normal labour progress has led to changing definitions of labour stages such that an additional hour is allowed before the second stage of labour is deemed prolonged; 3 h in primigravid women and 2 h in multiparous women without regional anaesthesia, 4 h in primigravid women and 3 h in multiparous women with regional anaesthesia [12,13]. UK National guidelines on intrapartum care do not differentiate between presence and absence of neuraxial anaesthesia in their definition of delay in the second stage nor do they consider length of passive second stage. The NICE guidelines

Table 1
American college of obstetricians and gynecologists criteria for types of forceps deliveries 2015.

Outlet forceps	Low forceps	Mid-cavity
Scalp is visible at the introitus without separating the labia Foetal skull has reached the pelvic floor Foetal head is at or on perineum Sagittal suture is in anteroposterior diameter or right or left occiput anterior or posterior position Rotation does not exceed 45°	Leading point of the foetal skull is at station+2 cm or more and not on the pelvic floor Without rotation: Rotation is 45° or less (right) With rotation: Rotation is more than 45°	Station is above +2 cm but head is engaged

instead define only a delay in *active* second stage of labour: in a nulliparous woman, the criteria are met at an active second stage lasting for 2 h, and in a multiparous woman, the duration is 1 h [13].

Lack of progress in the second stage of labour is deemed to be an appropriate indication for forceps-assisted delivery provided that absolute CPD is not suspected [5,6,9,10]. This means that thorough abdominal and vaginal examinations are required to ensure that the head is engaged within the pelvis (no more than 1/5th palpable abdominally usually 0/5th; leading part of the skull level with maternal ischial spines at station zero) and that caput and moulding are not excessive. Lack of engagement suggests that the foetus may be too big to fit through the maternal pelvis and thus an attempt to deliver by forceps is more likely to fail or be complicated by traumatic injury or shoulder dystocia.

Excluding absolute CPD in the context of a foetal malposition is more difficult and may not be possible before correcting the malposition and testing the pelvic capacity by applying traction. However, a clinical assessment of the foetal size should be carried out (in the absence of recent ultrasonographic assessment) to identify likely absolute CPD due to macrosomia. Where the foetal head is engaged (or just above ischial spines if in a deflexed occipito-posterior OP position) then an attempt to deliver by forceps once the occiput is rotated anteriorly is likely to be safe. Where the foetal head is not occipito-anterior, it may be rotated manually or using rotational forceps to this position first, before applying traction with either the same rotational forceps or with forceps designed for direct traction births. The ability to rotate the head easily is in itself a test of disproportion.

Foetal concerns

'Foetal distress' justifying expedited delivery of the foetus may be suspected based upon monitoring of the foetal heart rate usually by cardiotocography (CTG) or confirmed through foetal blood sampling [14,15]. A pathological CTG alone in acute circumstances or in combination with supporting ST-segment analysis or abnormal foetal capillary blood pH is each an indication for expediting birth. This can be by operative vaginal birth when the safety prerequisites are met. There may also be additional concerns regarding foetal well-being, for example in the context of meconium stained liquor and/or maternal pyrexia which may give rise to an indication for a forceps-assisted delivery.

Maternal concerns

Maternal conditions that may benefit from a shortened second stage of labour range from cardiac conditions in which cardiac output is limited (e.g. aortic stenosis), significant hypertension, spinal cord injury with the risk of autonomic dysreflexia, myasthenia gravis, proliferative retinopathy, antepartum haemorrhage through to maternal exhaustion-induced request for assisted birth [5].

Failed ventouse

The use of forceps after a failed attempt at ventouse-assisted delivery (sequential instrument use) has crept into clinical practice with the increasing preference for ventouse as a first-line instrument. Sequential instrument use is associated with an increased risk of trauma to the mother and infant [16,17]. However, the operator needs to balance the relative risks of a caesarean section following failed vacuum extraction with the risks of sequential instrument use. The use of outlet or low-cavity forceps following failed ventouse may be judicious in avoiding a potentially complex caesarean section [6].

Contraindications

Foetal conditions

Contraindications to forceps-assisted delivery include foetal conditions that put the foetus at risk of bony injury or intra- or extra-cranial haematoma formation. Relevant conditions include suspected

osteogenesis imperfecta and bleeding disorders, such as haemophilia or von Willebrand disease [5,6]. In each of these scenarios, where known, the risk of injury to the foetus is unacceptably high and forceps should be avoided. Osteogenesis imperfecta, a bone demineralisation condition, results in a foetus at high risk of foetal bone fractures and surrounding tissue injury during the forceps birth, while a bleeding disorder puts the foetus at risk of substantial cerebral haemorrhage and potential coagulopathy.

Cephalo-pelvic disproportion

Intrapartum contraindications to forceps-assisted birth, as mentioned earlier, include a high foetal head (2/5th or more palpable abdominally and/or station above the maternal ischial spines) or excessive caput and moulding, as these suggest CPD. Signs of CPD developing during an attempt to perform a forceps-assisted birth include failure of progressive descent with each pull, or where delivery is not imminent following three pulls of a correctly applied forceps in the hands of an experienced operator [6]. The experienced operator who is suspicious of CPD will move the patient to an operating theatre and make the diagnosis after one or at most 2 pulls of a well-applied instrument. This is often what is meant by 'trial of forceps' with a low threshold to proceed to caesarean section. If the foetal head position is unknown, the birth should not proceed with the use of forceps as this presents an unacceptable risk of foetal injury to the face, eyes, ears and skull.

Prevention of forceps-assisted birth

There is evidence to suggest that forceps (and vacuum) are less likely to be required when one-to-one support is provided in labour, and when low-dose epidural anaesthesia is used in preference to high dose [10,18]. The evidence for preventative strategies is otherwise conflicting or weak.

Delayed pushing

A randomised trial in the US demonstrated that difficult forceps-assisted births are less likely in nulliparous women with epidural analgesia who wait 2 h before active pushing in the second stage of labour [19]. However, a more recent US trial has challenged this, reporting that among nulliparous women receiving neuraxial analgesia, the timing of pushing during the second stage of labour did not affect the rate of spontaneous vaginal delivery [20].

Induction of labour

The association between induction of labour and assisted vaginal birth is controversial. A Cochrane review of over 12,000 women reported that induction of labour leads to a modest increased risk of forceps or ventouse-assisted birth {RR 1.10 (1.00–1.21)} [21]. However, this association has been questioned by findings from recent high-quality randomised controlled trials addressing low-risk pregnancies, women with macrosomic foetuses, and women aged over 35 years. Each of these trials demonstrated no increased risk of operative vaginal birth following induction of labour [22–24]. This raises the possibility, as with the findings for delayed versus immediate pushing, that the association may be with previously used high-dose/heavy-block epidural anaesthesia techniques, rather than induction of labour.

Labour management

Interventions shown to be ineffective in reducing OVD rates are partogram use, early artificial rupture of membranes (ARM), avoiding epidural before 3 cm cervical dilatation and walking during labour [10]. Although somewhat counterintuitive, the BUMPES trial reported that being upright with epidural anaesthesia did not reduce the OVD rate and in fact the rate of spontaneous vaginal birth was high in lateral lying positions [25,26]. It is currently unclear whether manually rotating a foetal malposition from posterior to anterior reduces OVD, rates but a number of randomised controlled trials have been registered to test this hypothesis [27,28].

Choosing forceps

When a forceps-assisted birth is being considered, the risks and benefits of the options available must be considered. The alternatives include expectant management awaiting spontaneous vaginal birth, vacuum-assisted birth or second-stage caesarean section.

When to intervene

The choice of intervention to expedite birth (if any) should reflect the clinical circumstances of the case as none of the options are definitively safer when a range of outcomes are taken into account. Relative advantages and disadvantages of each approach are related to the maternal and foetal condition, the stage of labour and the woman's values and preferences. The decision-to-delivery interval (DDI) will be particularly important where the indication is suspected foetal compromise [4].

Qualitative evidence from a simulation study of ten experienced obstetricians demonstrated that clinicians consider a multitude of factors before deciding when, how and where to conduct an assisted vaginal birth and whom should be present for the birth. Factors include whether the foetus shows signs of distress, whether contractions are adequate or maternal pushing is effective, whether delivery of the head is being arrested by the perineum and the position and station of the foetal head [29]. For example, if a foetus is not distressed, the woman is tired but continuing to push effectively, the vertex is just below the level of the ischial spines and she has stated a wish to avoid the risk of OASI over any other adverse outcome, then it may be more appropriate to manage expectantly at the first instance.

The woman should be involved in the decision to expedite birth and she should understand the reasons, the alternatives and the risks involved. These are the essential legal components of obtaining informed consent [30,31]. A plan to perform a forceps-assisted birth should therefore reflect an informed and shared decision. Ultimately a competent woman can decline to have a forceps-assisted birth regardless of the potential outcome for her or her baby [32].

What instrument to use

The obstetrician will wish to choose the approach that is most likely to be effective in completing the delivery with the least morbidity (see Table 2). Evidence on effectiveness of forceps compared with ventouse has come from several randomised controlled trials, with the findings of 13 trials synthesised in a Cochrane review in 2010. This demonstrated that forceps was less likely to fail than ventouse (risk ratio (RR) 0.65, 95% confidence interval (CI) 0.45 to 0.94). Deciding between forceps and ventouse depends on multiple factors including the operator's skills and experience, and features that affect how likely a ventouse is to succeed (e.g. maternal effort, degree of analgesia, caput and moulding) [5]. While a forceps birth takes a similar amount of time to ventouse, the operator needs to be cognisant of the high failure rate with ventouse; therefore, the degree of foetal urgency may play a role in the final decision [4]. The risk–benefit profile of each should be considered and, where possible and appropriate, discussed with the woman before proceeding.

Table 2
Table of evidence (systematic review and randomised trials) comparing forceps and ventouse for non-rotational-assisted vaginal birth.

Primary author; Year	Setting	Sample size	Findings
O'Mahony, 2010 [40]	Cochrane Collaboration	6597 (32 trials)	Forceps compared to vacuum associated with: Increased maternal perineal trauma and pelvic floor dysfunction; lower failure rate; increased neonatal facial injury; lower retinal haemorrhage.

Forceps safety factors

Case-specific factors to be considered when deciding to perform a forceps-assisted birth include confirmation of the presence of key prerequisites based on expert opinion: vertex presentation; cervix fully dilated; engagement of the foetal head with no more than one fifth palpable abdominally; knowledge of the foetal head position; membranes ruptured; degree of caput and moulding assessed (and not excessive); adequate pelvic capacity; descent on maternal expulsive effort; informed consent; adequate analgesia; empty bladder; aseptic conditions achievable; appropriately skilled clinician; equipment available; facility for recourse to caesarean section; anticipation of complications and resources to manage these [5].

It may be decided that a forceps-assisted birth should be performed in an operating theatre where access to caesarean birth without delay is achievable. Examples of such scenarios include presence of moderate caput or moulding, need for rotation of the foetal head or a subjective impression of suboptimal pelvic dimensions and/or a large baby. A contingency plan should always be in place in case of failure, and this will almost always require delivery by caesarean section.

Forceps versus caesarean section

A decision to perform a caesarean section in preference to forceps is supported by evidence of a high head (2/5th or more palpable abdominally, vertex above ischial spines), excessive caput or moulding, no rotation possible on attempting to correct a malposition or the impression of insufficient pelvic dimensions [29]. The decision whether or not to perform a caesarean birth should be influenced not only by the clinical findings on vaginal examination but also by the expertise of the clinician and the preferences of the woman (see Table 3). If the vaginal examination suggests no evidence of CPD, then a forceps birth may be considered appropriate, but this should be decided in the context of the potential morbidities. All decisions that have a potential impact on future pregnancy outcomes should consider long-term risks. The woman who has a forceps-assisted delivery completed safely has a far high chance of a spontaneous vaginal birth in a subsequent pregnancy (80% versus 30%) [33]. Alternatively, the woman who has a forceps-assisted birth complicated by significant maternal or neonatal complications is more likely to request an elective caesarean section in a subsequent pregnancy.

Choosing rotational forceps

In the UK, some maternity units use Kielland's rotational forceps (KRF) routinely to manage foetal malposition as a cause of second stage labour dystocia. KRF are usually selected from a set of options to manage a malpositioned foetal head where more than 45° of rotation is required to achieve the occipito-anterior position. Other option includes rotational ventouse or manual rotation followed by direct forceps-assisted birth. Rotational forceps differ from those designed for direct traction because they are intended for use to both rotate the foetal head to the anterior position and to deliver the foetal head. KRF feature a long shaft without a pelvic curve to minimise maternal trauma during rotation. However, in many settings, KRF, the most commonly used rotational forceps, are not used due to safety concerns surrounding their use [34]. A historical European case series of 86 infants born with KRF reported an associated mortality rate of 3.5% and birth trauma rate of 15% [35]. A much more reassuring safety profile for KRF has been reported in recent years. A systematic review of observational studies comparing rotational forceps with rotational ventouse demonstrated lower neonatal trauma rates (RR 0.62 (0.46–0.85, p = 0,003)), and a substantially lower failure rate (5.4% versus 16%) (RR 0.32 (0.14–0.76, p = 0.009)) with KRF. The same review found no difference in the incidence of postpartum haemorrhage, obstetric anal sphincter injuries (OASI) or extended vaginal or cervical tears between these approaches [36]. Meta-analysis was possible for only a small subset of outcomes, highlighting the need core outcome sets (COS) in this research area.

A UK cohort study reported in 2017 comparing 312 KRF with manual rotation and direct forceps-assisted births demonstrated low failure rate (11.5% vs 17.8%), high shoulder dystocia rates (19.2% vs 10.6%; RR, 2.35, 1.23–4.47) and equivalent maternal and perinatal outcomes with KRF [37].

Table 3
Table of evidence (observational studies) comparing attempted forceps-assisted birth and second-stage caesarean section.

Primary author; Year	Setting	Sample size	Key findings
Muraca, 2018 [42]	BC, Canada Retrospective cohort 2003–2013	10,901	Forceps associated with increased severe perinatal morbidity/mortality and severe maternal morbidity
Muraca, 2017 [41]	BC, Canada Retrospective cohort 2004–2014	187,234	Forceps associated with increased severe perinatal morbidity/mortality and severe maternal morbidity
Murphy, 2004 [55–57]	Bristol, UK Prospective cohort	393	Caesarean associated with increased PPH, prolonged maternal hospital stay Caesarean associated with increased NICU admissions Forceps associated with increased neonatal trauma

*PPH = postpartum haemorrhage.

Outcomes of forceps-assisted birth

No COS specific to operative vaginal birth exists currently, although there is one in development and registered on the COMET database [38]. However, there are published core outcomes on models of maternity care that reflect the priority outcomes from service users' and clinicians' perspectives [39].

Randomised studies assessing outcomes of forceps-assisted birth compared with ventouse have been evaluated in a Cochrane systematic review published in 2010 [40]. Outcomes comparing forceps-assisted birth with caesarean section are discussed based upon two recent large observational studies by the same author comparing assisted vaginal births with intrapartum caesarean births in Canada 2003–2013 and 2004–2014, respectively [41,42]. Subgroup analyses of births in the context of prolonged second stage of labour and according to whether forceps or ventouse was used are discussed specifically. The primary outcomes in each study were composite severe perinatal morbidity and mortality (e.g. convulsions, assisted ventilation, severe birth trauma and perinatal death) and composite severe maternal morbidity and mortality (e.g. severe postpartum haemorrhage, shock, sepsis, cardiac complications, acute renal failure and death) (Table 3) (see Table 4).

Maternal complications

Perineal trauma

Because of the nature of obstetric forceps, it is common to encounter episiotomy (~90%), perineal tears (~20%) or obstetric anal sphincter injury (OASI (~10%)) during their use [5]. When compared in randomised trials with ventouse, there is no clear difference in the rate of episiotomy being performed with forceps, although there is significant heterogeneity between studies. There is also no

Table 4
Evidence on outcomes of rotational forceps versus alternative approaches to expediting birth.

Author; Year	Setting/Design	Sample size	Findings
Wattar, 2015 [36]	Systematic review of observational studies comparing rotational forceps with rotational ventouse	5870 rotational forceps births	Rotational forceps had lower neonatal trauma rates and a substantially lower failure rate than rotational ventouse. No differences in risk of postpartum haemorrhage, anal sphincter injuries or extended vaginal or cervical tears were found.
O'Brien, 2017 [37]	Retrospective cohort	312 rotational forceps births	Higher success rate in achieving vaginal birth with forceps, greater shoulder dystocia but not neonatal injury. No differences in other maternal or neonatal outcomes.

difference in rate of combined episiotomy and tear requiring suturing or of vulval trauma. However, third- and fourth-degree tears are more likely with forceps use whether or not episiotomy is performed (10 studies – RR 1.89, 95% confidence interval 1.51–2.37) as is vaginal trauma (8 studies – RR 2.48, 95% CI 1.59–3.87). In the only trial assessing risk of incontinence of flatus or altered continence following forceps or ventouse, forceps was associated with higher risk of this outcome (RR 1.77, 95% CI 1.19–2.62) [40].

Muraca et al., in their 10-year Canadian cohort study, reported overall risks of obstetric trauma {defined as any of severe perineal lacerations (third or fourth degree), cervical laceration, high vaginal laceration, injury to pelvic organ/joint, pelvic haematoma or extension of uterine incision} following mid-cavity forceps-assisted births [42]. The risk of obstetric trauma compared to second-stage caesarean section was increased eightfold in the context of labour dystocia and fivefold in the context of foetal distress.

A systematic review of studies comparing rotational forceps with rotational ventouse has not identified any difference in risk of significant perineal injury (extended vaginal tears, cervical tears or third- or fourth-degree tears) [36]. The pooled event rate of OASI from 16 studies was 5.6%. A more recent study of outcomes of rotational forceps compared with manual rotation followed by direct forceps reported OASI rates of 9.6% and 5.8%, respectively, which were not statistically significant (aRR 1.99, 0.90–4.39).

Role of episiotomy and perineal protection

It is accepted practice to perform an episiotomy during a forceps birth, with moderate quality evidence suggesting that this will reduce the risk OASI. The use of mediolateral episiotomy during both vacuum- and forceps-assisted delivery has been associated with a 5- to 10-fold reduction in the rate of OASI in primiparous and multiparous women in a study of over 130,000 births in the Dutch Perinatal Registry [43]. The incidence in forceps-assisted births for primips was 3.4% with right mediolateral episiotomy and 26.7% without. The incidence in multiparous women was 2.6% and 14.2%, respectively [43]. There is some evidence to suggest that perineal protection can prevent these injuries. Education programmes have been linked to a 48% reduction in OASI in all vaginal births in Norway after introduction of a perineum protection training programme for midwives and physicians [44]. A formal teaching and training session on performing forceps-assisted births for trainee doctors has also been associated with a 26% reduction in severe perineal laceration following forceps birth in a US study of 4279 deliveries [45].

Pelvic floor morbidity and incontinence

Evidence from a cohort study of 3763 women in the UK and New Zealand demonstrates that long-term (12 year) urinary stress and urge incontinence rates are higher following forceps-assisted birth than caesarean section, with 19% versus 13% of women experiencing stress incontinence after forceps use, 4.5% versus 3.0% urge incontinence and 13% versus 8.2% both types, respectively [46]. Forceps have been associated with a higher rate of pelvic organ prolapse than caesarean birth (61% versus 5.9% pelvic organ prolapse in any compartment) when a cohort of women were assessed 15–24 years following childbirth [47]. The same study reported that 5% (8/159) of women who experienced a forceps-assisted birth went on to have surgery for prolapse compared with no women in the caesarean birth group (0/101) [47].

Postpartum haemorrhage

Cochrane review evidence demonstrates no difference in maternal blood loss between forceps and ventouse-assisted birth, although only two studies reported this outcome, and one had only 36 participants [40]. In the context of rotational forceps, a pooled event rate of postpartum haemorrhage of 6.5% (range 4.2–9.9%) was reported from 16 studies. When compared with rotational ventouse, there was no significant difference in the risk of postpartum haemorrhage (RR 1.16, 0.76–1.78). When a forceps delivery is performed with the foetus at a low station, observational

evidence from 7046 (n = 6265 forceps and 781 caesarean) women in China suggests that the risk of minor postpartum haemorrhage is increased compared with a caesarean section [48]. Similarly, the Canadian study of 1763 attempted mid-pelvic forceps-assisted births compared with 2405 s-stage caesarean births for dystocia reported 21% postpartum haemorrhage and 1% severe postpartum haemorrhage following forceps and 4.62% and 0.5% following caesarean {AOR 4.39, 3.8–5.1) and 2.46 (1.43–4.25)}, respectively [42].

Analgesia requirements

Cochrane review evidence comparing forceps and ventouse-assisted births reported neither difference in local analgesia requirements for the procedure itself, nor any difference in pain at day four. Non-significant findings suggested regional anaesthesia was more likely to be used with forceps than ventouse. General anaesthesia was more commonly reported with forceps than ventouse.

Adverse psychological effects

A national survey of postnatal women in England in 2012 (n = 5332) demonstrated that negative psychological well-being and emotional trauma were more common with forceps delivery than any other mode of birth, with spontaneous vaginal birth and planned CS being associated with fewest psychological problems [49]. However, findings from the Norwegian Mother and Child cohort study (n = 55,814) found no association between birth mode and emotional distress levels up to six months postnatally [50]. This may reflect differences in circumstances surrounding operative vaginal births across the study settings. In qualitative studies, women describe negative birth experiences when not involved or participating in the decision for a forceps or ventouse-assisted birth. Positive experiences thus involved cooperation with and empowerment of the woman [51].

Future births

In a prospective cohort study of 393 women in the UK contacted three years from their first operative birth almost half wished to avoid a further pregnancy and half of these described this as being due to fear of childbirth [52]. There were no significant differences between forceps-assisted birth and second-stage caesarean section (1.75, 0.58–5.25). Of the women in the cohort who had a subsequent birth, they were far more likely to have a vaginal birth following a mid-pelvic forceps-assisted delivery than after a second-stage caesarean section (80% versus 30%) [33].

Offspring outcomes

Neonatal condition

The Cochrane review of randomised trials comparing ventouse and forceps–assisted births showed no difference in risk of low Apgar score, umbilical cord blood pH, neonatal admission or length of stay, as well as death or severe morbidity. However, the risk of facial injury was five-fold more common with the use of forceps than ventouse [40]. The Canadian retrospective cohort study compared attempted forceps (n = 4741) with second-stage caesarean section (n = 9300) in the context of prolonged labour and found a significantly increased risk of severe perinatal morbidity and mortality (1.1% vs 0.7%, AOR 1.81, 95% CI 1.24–2.64) with attempted forceps. This outcome was defined as any of neonatal convulsions; assisted ventilation by endotracheal intubation; severe birth trauma (e.g., intracranial laceration and haemorrhage, skull fracture, severe injury to the central or peripheral nervous systems, long bone injury, subaponeurotic haemorrhage and injury to the liver or spleen); stillbirth; and neonatal death [41]. However, the risk of selection bias remains as it is likely that the caesarean section group involved a higher station of foetal head compared with the attempted forceps group.

In the subsequent Canadian study of over 10,000 births in the second stage of labour with dystocia, mid-pelvic forceps birth was associated with a doubling of severe perinatal morbidity and mortality

compared with caesarean birth (as a first-line approach), affecting 1.7% following forceps and 0.83% following caesarean (ARR 2.11, 1.46–3.07), with severe birth trauma affecting 0.29% and 0.96%, respectively (ARR 4.3, 2.31–8.11) [42]. No difference in risk of requiring assisted ventilation by endotracheal tube was found. When analysing the subgroup of deliveries for foetal distress, the increased risk of perinatal morbidity and mortality with attempted forceps use was not statistically significant, no difference in 5-min Apgar scores or respiratory distress was found but a slight reduction in assisted ventilation by endotracheal tube followed attempted forceps birth compared with caesarean {1.13% and 1.08% ARR 0.69 (0.49–0.97)}.

Eye injury

Ophthalmic injuries are a recognised complication of forceps births with case series' suggesting rates of 'minor external trauma' to the eye of 16% and 'ophthalmic injuries' ranging from eyelid bruising to nerve injury and corneal trauma of 0.2% [53,54].

Neurodevelopmental outcomes

The Cochrane review of trials comparing forceps-assisted delivery with ventouse showed no differences in neurodevelopmental outcomes at 5 years [40]. Similarly in a prospective cohort study in the UK comparing mid-pelvic and rotational forceps deliveries with caesarean section there was an increased incidence of traumatic injuries with forceps but no difference in neurodevelopmental outcomes at 5 years [55–57].

Rotational forceps injury

A systematic review of observational studies comparing alternative approaches to birth in the context of malposition reported neonatal trauma in 7.5% (range 4.5–12.1%) and admission to NICU of 8.9% (range 6.0–13%) following rotational forceps [36]. Neonatal jaundice following rotational forceps occurred at a rate of 19% (range 11–30%). Shoulder dystocia occurred in 4.3% (range 3–6.2%). Adverse foetal outcomes following rotational forceps include skull fracture (0.1% occurrence in meta-analysis) and mortality (0.3%) but there is no clear evidence to suggest that these outcomes are more likely following forceps use than alternative options for rotational vaginal birth.

Management of failed/abandoned forceps delivery

When a decision is made not to continue with a forceps-assisted delivery on safety grounds, birth should be achieved via caesarean section. At this stage in labour the foetal head is likely to be deep in the pelvis and potentially impacted. Operators must be well-versed in techniques to manage a deeply impacted foetal head as the time available to manage the problem is limited to minutes and complications for the mother and neonate can be significant. Randomised trial evidence on which techniques to apply to manage a deeply impacted foetal head at caesarean section were synthesised in a Cochrane review in 2016 [58].

Techniques used to disimpact the foetal head from the maternal pelvis include combining routine manual disimpaction from above (via uterotomy) with upward displacement of the foetal head from below (via assistant's hand in vagina). Relaxation of the uterine muscle may be achieved through use of glyceryl trinitrate spray sublingually. Further strategies to assist with manual disimpaction include using a head-down tilt on the theatre table. An alternative to these adjunctive measures involves delivering the foetus feet or breech first (reverse breech extraction). Cochrane review evidence suggests that breech delivery compared to vaginal disimpaction is associated with less maternal bleeding, infection and operation time, less admission of babies to the neonatal unit and no difference in the risk of neonatal trauma [58]. A further technique utilised involves delivering both shoulders first followed by the trunk, breech, limbs then the head. This 'Patwardhan' technique has been subject to small observational studies only, with a suggestion that it improves maternal outcomes [59].

More recently, a 'fetal pillow'™ has been developed and used in clinical practice which aims to lift the foetal head up and off the maternal cervix such that potential suction effect is broken and delivery at caesarean section more straightforward. The inflatable device is designed to hold 180 ml of water which is inserted once the maternal legs are straight on the theatre table. A randomised trial ($n = 240$) of the foetal pillow compared with usual practice at second-stage caesarean section has demonstrated a significant reduction in difficulty of delivery, shorter incision-to-delivery and operating time, less significant extension of uterotomy, less blood transfusion and no difference in perinatal outcome compared with routine practice [60].

Given the time pressure and potential complexity associated with second-stage caesarean section following an unsuccessful attempt at forceps-assisted birth, it is essential that the healthcare team are prepared and able to act quickly to facilitate an immediate caesarean section once the decision is made. This requires a high level of communication between obstetrics, theatre, anaesthetic, midwifery and paediatric teams and availability of relevant equipment, medication and personnel in case these are required [29].

Postnatal debrief

All women, who experience an attempted or actual forceps-assisted birth should be counselled postnatally to ensure they understand the context and indication for the assisted birth, any complications encountered, their recovery and what consequences there may be for future births. Qualitative evidence supports that this is a valued component of maternity care [61].

Summary

Forceps are a commonly used instrument for assisting vaginal birth. Interventions recognised to reduce the likelihood of forceps-assisted birth include one-to-one support in labour and low-dose rather than high-dose epidural. Older systematic reviews of randomised trials suggest that avoiding induction of labour reduces the risk of forceps-assisted birth although more recent trials have challenged this. Most procedural aspects of forceps delivery are based on expert opinion rather than robust evidence. Accepted indications include prolonged labour, suspected foetal distress, and maternal medical conditions that benefit from a shortened second stage of labour.

Maternal and offspring outcomes of forceps-assisted birth are reported in observational studies, and randomised trial evidence is limited largely to comparisons between forceps and ventouse. Forceps-assisted birth increases the risk of maternal episiotomy, perineal tears and anal incontinence compared to ventouse. When focusing specifically on mid-pelvic forceps-assisted births, observational studies suggest that severe maternal trauma is four-fold higher than for second-stage caesarean section. However, the completed vaginal birth rate with forceps is higher than with vacuum, and if second stage caesarean section is avoided the woman is far more likely to achieve an uncomplicated spontaneous vaginal birth in a subsequent pregnancy.

Offspring morbidity and mortality up to five years of age are similar when forceps- and ventouse-assisted births have been compared in randomised trials. Population based studies in the US and Canada suggest that second-stage caesarean section may be associated with a reduced risk of severe morbidity for the baby when compared with attempted mid-pelvic forceps delivery. However, the absolute risk appears to be small and five year follow up from a UK-based prospective cohort showed no differences in neurodevelopmental outcomes. There is observational evidence to support the use of low forceps as a safer alternative to second stage caesarean section by reducing the risk of perinatal morbidity including hypoxic ischaemic encephalopathy.

Counselling and informed consent in relation to forceps-assisted birth are particularly important, and given the complexities involved, this should start in the antenatal period and be raised again during labour if the possibility of intervention arises. Forceps-assisted births can have traumatic

psychological sequelae, which emphasises the importance of good communication skills as well as technical skills when conducting emergency deliveries.

Practice points

- Clinicians need to be aware of the indications and contraindications for forceps-assisted delivery and apply these on an individual basis according to the prevailing circumstances.
- When choosing between forceps-assisted delivery and ventouse, clinicians need to be aware of the higher success rate with forceps counterbalanced by the higher incidence of perineal trauma, including obstetric anal sphincter injury (OASI).
- When choosing between mid-pelvic forceps-assisted delivery and second stage caesarean section, clinicians need to be aware of the increased incidence of neonatal traumatic injury with forceps which may be counterbalanced by the increased incidence of subsequent uncomplicated vaginal birth.
- Clinicians who perform and supervise mid-pelvic and rotational forceps-assisted deliveries need to have clear stopping rules so that morbidity can be kept to a minimum.
- Clinicians need to be aware of the increased risk of foetal head impaction if a failed attempt at forceps-assisted delivery is not abandoned in a timely manner.
- Neonatologists should be alerted about sequential instrument use and failed attempts at forceps-assisted delivery so that neonatal traumatic injuries can be recognised at the earliest opportunity.
- Women need to be counselled about the risks and benefits of forceps-assisted delivery in a time-sensitive manner so that informed decisions can be made.

Conflict of interest

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bpobgyn.2019.02.002.

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