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Full length article

## Impacted fetal head during second stage Caesarean birth: A prospective observational study

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### ABSTRACT

**Objective:** To determine the incidence of, and complication rates from, impacted fetal head at full dilatation Caesarean birth in the UK, and record what techniques were used.

**Design:** Prospective observational study using the UK Obstetric Surveillance System (UKOSS).

**Setting:** 159 (82%) of the 194 UK hospitals with obstetric units.

**Population:** All women who underwent second stage Caesarean birth in the UK between 1st March and 31st August 2019. Further information was collected on cases where a dis-impaction technique was used, or the operating surgeon experienced 'difficulty' in delivering the head.

**Methods:** Prospective observational study.

**Main outcome measures:** Technique(s) used, maternal and neonatal outcomes.

**Results:** 3,518 s stage Caesarean births reported. The surgeon used a dis-impaction technique or reported 'difficulty' in 564 (16%) of these. The most common dis-impaction techniques used were manual elevation of the head by an assistant through the vagina (n = 235) and a fetal "pillow" (n = 176). Thirteen babies (2%) died or sustained severe injury. Four babies died (two directly attributable to the impacted fetal head).

**Conclusions:** Difficulty with delivery of the fetal head and the use of dis-impaction techniques during second stage Caesarean sections are common but there is no consensus as to the best method to achieve delivery and in what order.

### Introduction

Caesarean section rates are 31% in the US and 33% in the UK [1]. At least 5% are performed at full cervical dilatation (in the second stage of labour) and this proportion is rising [2,3]. Both maternal [4] and neonatal [5] complications are greater during the second stage. One reason is that when the cervix is fully dilated, the baby's head may be deeply engaged in the pelvis, a so-called 'impacted fetal head'. Delivery in this situation may be technically challenging if the obstetrician cannot

pass their hand between the bony maternal pelvis and the fetal head. A vacuum effect may also make head elevation difficult [6]. The uterus is also typically thinned and stretched making extension of the uterine incision more likely. Complications for the baby include bony fractures, hypoxic brain injury and death. Risks of complications are further increased if there has been a prior unsuccessful attempt at instrumental birth [7].

The definition of impacted fetal head is unavoidably subjective and there is no universally agreed definition. Estimates of the incidence of

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impacted fetal head at Caesarean birth from retrospective studies vary depending on the population considered between 1.5% [8] (48/3105 women) undergoing Caesarean), 11.3% (95/838 women undergoing emergency Caesarean) [9] and 63% (41/65 women undergoing Caesarean at full dilatation) [10]. Certainly one recent report suggests that birth injuries associated with impacted fetal head in the UK are now as common as those associated with shoulder dystocia [11].

Many different techniques have been advocated, including the Fetal Pillow [12]; the Patwardhan method [13]; the push technique [14]; reverse breech extraction [15], tocolysis and the Tydeman tube [6] but there are few data on how often they are used and which are most effective. A Cochrane review (4 trials, 357 women) comparing reverse breech extraction versus the push technique concluded that there was no difference for the baby in terms of birth trauma, that uterine extension, endometritis and blood loss were lower with the reverse breech extraction technique, but acknowledged the low quality of the evidence [16]. Two small trials suggest preventative use of the fetal pillow reduces adverse events compared with alternatives [12,17], but both had sufficient methodological weaknesses for the UK National Institute for Clinical Excellence (NICE) to judge the evidence inadequate to recommend the pillow outside well conducted trials [18]. Despite this, it is gaining popularity with increasing numbers of obstetric units publishing audits comparing it with other techniques [19] or with historical controls [20,21]. One large retrospective cohort comparing outcomes with the fetal pillow device found no significant maternal or neonatal benefit of using the device [22]. A 2016 Cochrane review of techniques for managing an impacted fetal head found only one trial (97 women) comparing the use of tocolysis with placebo concluded that there was no difference in ease of fetal extraction reported by the operating surgeon, unfortunately few maternal or neonatal outcomes were reported in this trial [23].

Our aim was to determine the incidence of, and complication rates from, impacted fetal head at full dilatation Caesarean birth in the UK, and record what techniques used are in use. This was performed as part of a wider scoping study commissioned by the National Institute for Health Research to determine the feasibility of designing a randomised trial comparing techniques for management of an impacted fetal head in the UK.

**Methods**

The UK Obstetric Surveillance System (UKOSS) was set up in 2005 [24] to collect population-based information about rare pregnancy events from all 194 consultant-led maternity hospitals in the UK. Over six months between 1st March and 31st August 2019 nominated reporting clinicians notified UKOSS of all pregnant women with a singleton fetus in cephalic presentation who had a Caesarean section during the second stage of labour. Further information (Appendix S1) was collected if any technique was used to assist delivery of the fetal head (either as a preventative measure when an impacted fetal head was anticipated or as treatment when an impacted fetal head was encountered) or where the operating surgeon deemed there to be ‘difficulty’ in delivering the fetal head. Reporting clinicians were sent regular reminders to return data at weeks one, two and three after notification.

The study is reported in accordance with the Strengthening the reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies [25]. The sample size was not pre-determined. Statistical analysis was conducted using SPSS Version 25. Data are presented as descriptive statistics (median, IQR) with the Kolmogorov Smirnov test used to assess the distribution of continuous data. Ethical approval was obtained from the North London REC1 (Ref. Number 10/H0717/20). Further information is available at <https://www.npeu.ox.ac.uk/ukoss/completed-surveillance/iff>.

**Results**

159 (82%) of the 194 hospitals with obstetric units in the UK, reported 3,518 s stage Caesarean sections, which we estimate [26] equates to 7.3% of emergency Caesarean births in those hospitals. Of 564 reports of the use of a dis-impaction technique or of “difficulty” delivering the head, two were duplicates and five referred to twins (second twin in four cases and unspecified in one). These were excluded leaving 557 reports (16% of second stage Caesarean births) in the final analysis.

*Characteristics of women who experienced an impacted fetal head*

Women and labour characteristics are included in Table 1, and operative findings in Table 2.

*Operator characteristics*

The grade of the initial operator starting the Caesarean is summarised in Table 2. 210 out of 557 cases were performed by an ST3-5 doctor (trainee obstetrician in their third-fifth year of their seven-year specialist training programme). Of those 210 cases, 153 (73%) were supervised by either a ST6-7 (trainee obstetrician in the final two years of their seven-year specialist training programme) or a consultant. The highest grade supervising operator where the initial operator was not a consultant is summarised in Table 2. The main initial operator was unsuccessful in delivering in 103 (19%) of cases. Presenting the lack of success at delivery by the initial operator as a proportion of deliveries undertaken by each grade of obstetrician, grade ST3-5 doctors were unsuccessful in delivery in 29% of cases, in comparison to 14% for ST6-7 and 10% for consultants.

The operator undertaking the attempted unsuccessful instrumental delivery is summarised in Table 2.

**Table 1**  
Demographic data for women included in the study.

Age (n = 556)		Median (IQR): 31 [27–34] years
Body mass index (n = 537)		Median (IQR): 26 [23,29] kg/m <sup>2</sup>
BMI group	Under 20	39 (7%)
	20–24.9	194 (36%)
	25–29.9	181 (34%)
	30–34.9	75 (14%)
	35 and over	48 (9%)
Ethnicity (n = 557)	White	453 (81%)
	Asian	67 (12%)
	Black	11 (2.0%)
	Mixed/any other ethnic group	21 (3.8%)
	Unknown	5 (0.9%)
Previous pregnancy > 24/40	Yes	114 (20%)
Previous Caesarean section		37 (6.6%)
Gestation at delivery		Median (IQR): 40 <sup>+2</sup> (39 <sup>+3</sup> –41 <sup>+1</sup> ) weeks
Length of first stage		Median (IQR): 8 h 15 min (5.0 – 12.03)
Length of second stage		Median (IQR): 2 h 59 min (1.49 – 3.58)
Onset of labour	Spontaneous	283 (51%)
Indication for induction of labour (n = 273; 49%)	Fetal concerns	90 (33%)
	Maternal concerns	56 (21%)
	Post dates	59 (22%)
	Prolonged rupture of membranes	35 (13%)
	Maternal request	3 (1%)
	Other/not reported	30 (11%)
Syntocinon use	Yes	352 (64%)

**Table 2**  
Indication for induction or labour or Caesarean section and grade of operator performing the Caesarean section.

Characteristic	Findings	Number (Percentage)
Position of fetal head prior to delivery	Occipito-posterior (OP)	257 (46%)
	Occipito-transverse (OT)	160 (29%)
	Occipito-anterior (OA)	108 (19%)
	Brow	8 (1.4%)
	Not reported	24 (4.3%)
Station of fetal head	At or below ischial spines	407 (73%)
	Above spines	142 (26%)
	Not reported	8 (1.4%)
Prior unsuccessful attempt at instrumental delivery	Yes	316 (57%)
	Ventouse	96 (30%)
	Forceps	244 (77%)
	Dual instrumentation	24 (7.6%)
	Rotation	204 (65%)
	- manual	97 (48%)
	- rotational forceps	59 (29%)
	- rotational ventouse	35 (17%)
- multiple methods	23 (11%)	
Grade of operator performing unsuccessful instrumental delivery (n = 316)	ST3-5 (residents)	91 (29%)
	ST6-7 (residents)	110 (35%)
	Consultant (attending)	88 (28%)
	Other	27 (8.6%)
Indication for Caesarean section (n = 557)	Failed instrumental attempt	242 (43%)
	Prolonged second stage	174 (31%)
	Fetal compromise	92 (17%)
	Malposition	20 (4%)
	Maternal compromise/request	8 (1.4%)
	Not reported	21 (4%)
Grade of operator for Caesarean section (n = 557)	ST3-5 (residents)	210 (38%)
	ST6-7 (residents)	171 (31%)
	Consultant (attending)	78 (14%)
	SAS doctor	49 (9%)
	Other/not reported	49 (9%)
Highest grade of operator present for Caesarean section (supervising) (n = 482)	ST3-5 (residents)	50 (10%)
	ST6-7 (residents)	216 (45%)
	Consultant (attending)	212 (44%)
	Not reported	4 (1%)
Category of Caesarean section	1 (Immediate threat to life of woman or fetus; within 30 min)	260 (47%)
	2 (No immediate threat to life of woman or fetus; within 75 min)	291 (52%)
Anaesthesia	Regional	506 (91%)
Uterine incision to delivery interval		Median: within 3 min (2–5 min)

ST3-5 or a junior registrar is a trainee obstetrician in their third-fifth year of their seven year specialist training programme equivalent to a resident; ST6-7 or a senior registrar is a trainee obstetrician in the final two years of their seven year specialist training programme equivalent to a resident; SAS are non-training posts that include staff grade, associate specialist and specialty doctors with at least four years of postgraduate training; and, consultant is a doctor who has completed all of their specialist training equivalent to an attending physician.

#### Techniques, and the order in which they were used

The vaginal push technique was used as treatment on 167/557 (30%) of occasions and ranked as the first technique by the majority of operators (Table 3). It was also used as a preventative measure, on 68

further occasions. The fetal pillow was used 142 times as a preventative measure (25%) and 34 times as treatment, in all cases the pillow was placed and inflated. Of the 78 (14%) of cases where tocolysis was used, the drug was GTN in 37 cases, (47%), terbutaline in 33 cases, (42%), salbutamol in 3 cases, (4%) and a combination of terbutaline and GTN in 5 cases, (6%).

#### Maternal and neonatal outcomes

Maternal and neonatal complications are summarised in Table 4.

In total fifteen babies (3%) died or sustained severe injury. Three babies suffered more than one complication and one baby who died in the neonatal period also sustained two severe injuries. Seven suffered fractures, two plexus injury and one facial palsy. Three had moderate or severe hypoxic ischaemic encephalopathy, and seven were cooled. Four babies died (two stillbirths and two neonatal deaths): one stillbirth occurred prior to the Caesarean; one neonatal death was attributable to multiple abnormalities; two deaths (one stillbirth and one neonatal death) were directly attributable to the impacted fetal head.

#### Discussion

##### Main findings

Impacted fetal head is common and can result in significant maternal and neonatal complications. 6.1% of mothers require intensive care as a result of this condition which has not previously been reported. It is most often treated by an assistant pushing the head up vaginally during the Caesarean section.

##### Comparison with previous studies

This is the first prospective study of obstetricians' current practices in situations involving an impacted fetal head, and the findings are supported by a previous UK survey [27]. In one UK institution in 2015 the push technique was the only one employed [10]. Rice et al. [10] also reported that in 18% of all emergency Caesarean births, which amounted to 63% of Caesarean sections at full dilatation, the surgeon reported some difficulty with delivery of the fetal head. This was inversely related to the seniority of the surgeon with, in that series, only trainee obstetricians needing to use additional techniques [10]. Another retrospective Swiss cohort between 2012 and 2016 reported that 22% of all emergency operations required disimpaction [28]. Again the push technique was most commonly used (60%) followed by reverse breech extraction (40%). The latter was associated with significantly lower rates of uterine extensions, shorter operation times and less blood loss. A randomized trial also found that reverse breech extraction is associated with a significant reduction in operative duration, uterine extension, blood loss, post-operative pyrexia and wound infection [29].

The fetal pillow was first reported in 2014, originally called the Fetal Disimpaction System [30]. Evidence from small studies suggests it reduces maternal complications, particularly uterine extension [19–21] but the quality of the evidence has been judged low by the National Institute for Health and Care Excellence in the UK [18] who recommend further research before it is introduced. Despite this, it is the most popular preventative strategy. Some units reported mandating use of the pillow in all Caesareans following unsuccessful instrumental birth. The pillow was also used as treatment, albeit less commonly than the push technique.

Given the urgency of the situation, some authorities [31] have suggested an algorithm (ALERT) to standardise the approach, Alerting the team early, Lower the table and head down tilt, Extend the incision, Relax the uterus with tocolytic and engage Techniques. However, tilt (14%), tocolysis (12%) and extending the uterine incision (11%) were much less commonly performed than the push technique, indicating this guidance is not commonly followed. Training in and promotion of

**Table 3**

Techniques used in anticipation of or to deal with an impacted fetal head at the time of Caesarean section at full dilatation and the rank order at which they were used.

Technique	Use	Numbers	Rank					Not spec.
			1	2	3	4	5	
Fetal pillow	Anticipatory	142	163	10	1			2
	Therapeutic	34						
Push technique	Anticipatory	68	186	28	10	1	1	9
	Therapeutic	167						
Reverse breech	Anticipatory	0	5	12	15	6	7	3
	Therapeutic	47						
Patwardhan	Anticipatory	1	1	2		2		1
	Therapeutic	5						
Tydeman tube	Anticipatory	0						1
	Therapeutic	1						
Head down tilt	Anticipatory	21	32	33	2	1		8
	Therapeutic	55						
Tocolysis	Anticipatory	13	25	23	8	4		7
	Therapeutic	54						
Extend uterine incision	Anticipatory	2	12	27	10	7		4
	Therapeutic	58						

**Table 4**

Maternal and neonatal complications.

Maternal complications (n = 557)	
Uterine rupture before start of procedure	2 (0.4%)
Extension of the uterine incision	120 (22%)
Blood loss > 1,000 ml	146 (26%)
Median blood loss (range) in this group	1300 ml (1000–7160 ml)
Bladder injury	5 (0.9%)
Hysterectomy	3 (0.5%)
Bowel injury	2 (0.4%)
Sepsis	27 (4.8%)
Intensive care (level 2 or 3)	34 (6.1%)
Maternal death	0
Baby outcomes (n = 557 babies unless stipulated)	
Birthweight mean (IQR)	3.58 kg (3.24 – 3.88 kg)
Cord arterial pH < 7.1 (n = 417)	67 (16%)
Apgar < 7 at 5mins	46 (8.4%)
Apgar 7 at 10 min	11 (2.3%)
Hypoxic ischaemic encephalopathy	3 (0.5%)
Skull fracture	5 (0.9%)
Long bone fracture	1 (0.2%)
Clavicular fracture	1 (0.2%)
Brachial plexus injury	2 (0.4%)
Facial palsy	1 (0.2%)
Stillbirths <sup>1</sup>	2 (0.4%)
Neonatal deaths	2 (0.4%)
Neonatal care admission	69 (12%)
Cerebral cooling	7 (1.3%)

<sup>1</sup> one diagnosed before Caesarean. One during delivery.

simple measures is required.

Few UK obstetric units have 24 h consultant presence and most second stage Caesarean births are carried out by trainees [32]. In this study only (34%) were conducted or supervised by a consultant. Most women had received syntocinon (64%), had fetal malposition at the point of birth (81%) and had a preceding unsuccessful attempt at instrumental delivery (57%). Consistent with previous studies [12,19–21] maternal complications such as uterine extension (22%) and post-partum haemorrhage (26%) are relatively common, whereas serious neonatal complications are less so (2%).

**Strengths**

A well-established national network was used to collect data with a high level of engagement from units. Data was collected prospectively. This is the first prospective dataset of current practice of impacted fetal headreported in the literature.

**Limitations**

The definition of impacted fetal head is unavoidably subjective and practice is confounded by unit policies, clinical experience and skill of the operator.

**Implications for practice**

Simulation based educational packages e.g. Desperate Debra [31], or theoretical introduction and algorithm use supported by simulation [32], have demonstrated improvements in knowledge, skills and self-confidence. The ALERT algorithm should be publicised. The Tydeman tube [6], is not currently in use as it is in the early stages of commercialisation but is an exciting development for the future.

**Implication for research**

Although the emergency nature of the problem means that clinical trials will be challenging, successful emergency trials in labour are increasingly common [33–36]. Further work is ongoing to decide whether a trial of different techniques of managing impacted head is feasible [37]. In view of the increased use of anticipatory measures, any such trial should be undertaken promptly before evidence-free practice becomes embedded. There are promising new devices [6] and proposed training algorithms for impacted fetal head which warrant further evaluation.

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**Declaration of Competing Interest**

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: All authors have completed the Unified Competing Interest form (available on request from the corresponding author) and declare: NIHR HTA grant funding to support the submitted work, JD declares grants from NIHR, during the conduct of the study; grants from NIHR, from CIHR, from IWK, grants from Nova Scotia Research, outside the submitted work. All authors declare no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, no other relationships or activities that could appear to have influenced the submitted work.



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## Contribution to authorship

NJ wrote the first draft of the manuscript with contributions from KFW, MK and JGT. NJ did the analyses. All authors edited and approved the final version of the article. All authors contributed to the development and conduct of the study. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. KFW is the guarantor.

## Details of ethics approval

Ethical approval was obtained from the North London REC1 (Ref. Number 10/H0717/20).

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejogrb.2022.03.004>.

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