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COMPARISON OF MATERNAL OUTCOMES BETWEEN PULL BREECH OUT VERSUS PUSH IMPACTED HEAD UP FOR DELIVERY OF DEEPLY IMPACTED FETAL HEAD AT FULL DILATION IN EMERGENCY CESAREAN SECTION

Dr. Ujala Naz[*1], Dr. Najma Bano Shaikh[2], Dr. Kanwal[3]

[*1]*FCPS Trainee, Department of Gynecology & Obstetrics, Liaquat University of Medical and Health Sciences (LUMHS), Hyderabad*
[2,3]*Liaquat University of Medical and Health Sciences (LUMHS), Hyderabad*

[*1]nazujala05@gmail.com

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Corresponding Author: *
Dr. Ujala Naz

Abstract

Background

The Push method is widely practiced for delivering a deeply impacted fetal head during cesarean section but is often associated with serious maternal complications. The Pull (reverse breech extraction) method has been proposed as a safer alternative, yet it remains underutilized and lacks strong evidence in clinical guidelines, especially in low-resource settings.

Objective

This study aimed to compare maternal outcomes between the Pull and Push methods.

Material and Methods

A randomized controlled trial was carried out over six months in the Department of Obstetrics and Gynecology at Liaquat University of Medical and Health Sciences, Jamshoro. A total of 98 women underwent emergency cesarean section at full dilatation for a deeply impacted fetal head were enrolled and randomly assigned to Pull (n = 49) or Push (n = 49) groups. Baseline data included maternal age, gestational age, parity, residential status, and anesthesia type. Outcomes assessed were uterine incision extension, intraoperative blood loss, need for transfusion, operative duration, and hospital stay. All participants received standardized perioperative care, and statistical analysis compared outcomes both overall and across subgroups.

Results

The Pull method showed significant advantages, with lower rates of uterine incision extension, less blood loss, shorter operative time, and fewer transfusion requirements. Length of hospital stay did not differ between groups. The protective effect of Pull was particularly notable in older women, those with higher gestational age, and under spinal anesthesia.

Conclusion

Compared with Push, the Pull method provides safer and more efficient maternal outcomes in cases of deeply impacted fetal head. Its simplicity, effectiveness, and

low cost make it a valuable option for improving maternal safety, especially in resource-constrained settings.

INTRODUCTION

Impacted fetal head (IFH) is a well-recognized complication encountered during cesarean delivery (CS), particularly at full cervical dilatation in the second stage of labor. It occurs when the fetal head becomes deeply lodged in the maternal pelvis, making extraction technically challenging and significantly increasing the risks of both maternal and neonatal complications. For the mother, IFH is strongly associated with complications such as uterine incision extensions, broad ligament injury, postpartum hemorrhage (PPH), bladder trauma, and prolonged operative time. For the neonate, risks include birth trauma, hypoxia, and in severe cases, perinatal death (Mandlik & Chavan; Bloch et al., 2021). [1],[2] With the global rise in cesarean deliveries (CS), reports of IFH have become more frequent, particularly in emergency procedures at full dilatation (Faiza et al., 2022). [3]

Traditionally, the most commonly used maneuver is the vaginal push technique, where an assistant elevates the fetal head from below. However, this method is associated with several drawbacks, including surgical site contamination, difficulty in accessing a deeply impacted head, increased uterine wound extensions, greater blood loss, longer operative repair times, and potential neonatal injury from direct pressure on the skull (Beeresh et al., 2016; Barwise et al., 2023; Cornthwaite, 2020). [4], [5], [6]

As an alternative, the reverse breech extraction (pull technique) has gained favor. In this method, the surgeon grasps the fetal feet within the uterus and delivers the baby gradually, allowing the head to emerge last. Originating from the Patwardhan method, this technique has been adopted in multiple centers due to evidence showing lower maternal trauma, reduced blood loss, and shorter surgical duration (Beeresh et al., 2016; Lenz et al., 2019; Faiza et al., 2022). [3],[4],[7] Nonetheless, some concerns remain regarding the requirement of a larger uterine incision, which could affect healing and future fertility (Barwise et al., 2023). [5]

Despite multiple available techniques, no universal consensus exists regarding the safest approach to IFH. Practices remain heterogeneous across hospitals and many clinicians still favor the push method despite higher complication rates (Ragbourne et al., 2024). [8] The absence of standardized training for obstetricians, anesthesiologists, and midwives further adds to inconsistent outcomes (Mandlik & Chavan; Ragbourne et al., 2024). [1],[8]

The management of impacted fetal head during emergency cesarean section remains a major obstetric challenge. While both push and pull techniques are practiced, the existing literature demonstrates conflicting evidence on their relative safety and effectiveness. The push method, though widely used, has been repeatedly linked to higher maternal morbidity. In contrast, the pull method shows promise in reducing complications but still lacks universal adoption and context-specific validation. This inconsistency creates uncertainty in clinical decision-making, particularly during emergency situations at full dilatation. Addressing IFH is vital because of its direct impact on both maternal and neonatal health. Determining which technique-push or pull-minimizes complications such as uterine extension, excessive bleeding, and surgical trauma can guide obstetricians toward safer, evidence-based practice. Beyond immediate safety, reducing intraoperative injuries contributes to better long-term maternal health, including preservation of fertility and reduced risk of complications in future pregnancies. This study therefore has the potential to influence standardized clinical protocols, improve patient outcomes, and strengthen training for obstetric teams worldwide.

This study focuses on comparing maternal outcomes between the push and pull techniques in cases of deeply impacted fetal head during emergency cesarean section at full dilatation. Primary outcomes of interest include uterine incision extensions, intraoperative blood loss, operative time, and related maternal morbidities. Limitations of this study include variability in

operator experience, case mix, and intraoperative adjuncts (e.g., tocolysis, operator switch), which may influence outcomes. Additionally, findings may not be generalizable across all healthcare systems, especially in low-resource settings where surgical facilities and training differ.

Impacted fetal head (IFH) at emergency cesarean section (CS), particularly at full dilation, is consistently linked with difficult extraction and heightened maternal risk (uterine incision extensions, hemorrhage, longer operative time) and variable neonatal morbidity. Large service evaluations show IFH is not rare and clusters with signs of obstructed labor such as caput, molding, and mid/low station, underscoring the need for skilled, standardized disimpaction. [9] Against this backdrop, reverse breech extraction ("pull") and head push ("push") are the two most used techniques; center-level practice varies widely, and operator training is inconsistent. [9],[10] The clinical question, therefore, is not whether to intervene, but which technique minimizes maternal harm when a deeply impacted head is encountered in emergency CS.

Observational cohorts and single-center trials repeatedly suggest maternal advantages with the pull technique, yet heterogeneity persists in patient selection, operator seniority, and co-interventions (tocolysis, change of operator). [9],[10] Earlier datasets often lacked standardized outcome definitions (e.g., what qualifies as "extension") and infrequently adjusted for intrapartum confounding (station, OP position, failed assisted birth). [9] Moreover, while meta-analytic work now favors traction-based methods, many included studies are small, single-center, or retrospective, limiting certainty and external validity. [10] These gaps justify a focused comparison of maternal outcomes between pull and push in modern emergency CS practice.

Across the literature, "push" refers to vaginal elevation/flexion of the head by an assistant while the surgeon delivers cephalically; "pull" denotes reverse breech extraction with controlled traction on the feet so the head is delivered last. The framework is consistent: randomized or quasi-randomized comparisons [12],[14], prospective cohorts [11],[16], and retrospective series [9],[13],[15] contrast rates of uterine incision extension, blood loss, operative time, wound complications, and length of stay; neonatal endpoints (Apgar, NICU, trauma) are typically secondary [11],[12],[13],[14], [15],[16]. System-level studies also catalog adjuncts (tocolysis, operator switch) that may modify risk but do not negate the core push-versus-pull contrast. [9]

Prospective and randomized data repeatedly show lower maternal trauma with pull. In a prospective comparative study of 80 women in advanced labor, pull halved uterine extensions (20% vs. 50%), shortened operative time, and reduced blood loss without worsening neonatal outcomes. [11] A randomized trial of 110 women similarly found far fewer extensions (9.1% vs. 45.5%), shorter operations, and ~450 mL less blood loss with pull. [12] Another RCT in prolonged second stage reported markedly higher extension rates with push (79% vs. 21%), cementing the maternal advantage of pull. [14] Observational evidence aligns: a 148-patient series showed pull reduced intra-operative injuries (uterine artery injury, vertical/transverse extensions) and postoperative fever, wound infection, transfusion, and length of stay, with comparable neonatal outcomes. [13] A large retrospective analysis of 182 advanced-labor CS demonstrated a dramatic reduction in extensions with pull (2.2% vs. 22.8%). [15] A prospective Egyptian cohort of 40 women reported fewer intra- and postoperative complications, lower wound infection, and shorter hospitalization with pull. [16]

At the system level, a one-year UK cohort (n=838 emergency CS; 95 IFH) quantified the context in which IFH arises augmentation with oxytocin, full dilation, mid/low station, molding/caput—and showed independent associations between IFH and uterine extensions and prolonged operative time. [9] Techniques used included both push and pull, often with adjuncts, but variation in adoption highlighted the lack of standard algorithms. Complementing these primary studies, a 19-study meta-analysis (n=2,345) concluded that "pull" carries lower maternal risk than "push," and that Patwardhan is safer than push or mixed push-and-pull approaches. [10]

Across randomized trials, prospective cohorts, and meta-analysis, reverse breech extraction consistently lowers maternal morbidity especially uterine incision extensions, blood loss, and operative duration without clear neonatal disadvantage compared with head pushing. [11],[12],[13],[14], [15],[16] System-level data further emphasize how frequently IFH coexists with obstructed labor features and how operator choices vary. [9] The persistent heterogeneity in definitions, case-mix, and training underscores the need for rigorous, context-specific comparisons. Study explicitly comparing maternal outcomes between pull and push for deeply impacted heads at emergency CS addresses a clinically decisive gap and is well aligned with the cumulative direction of evidence favoring traction-based techniques.

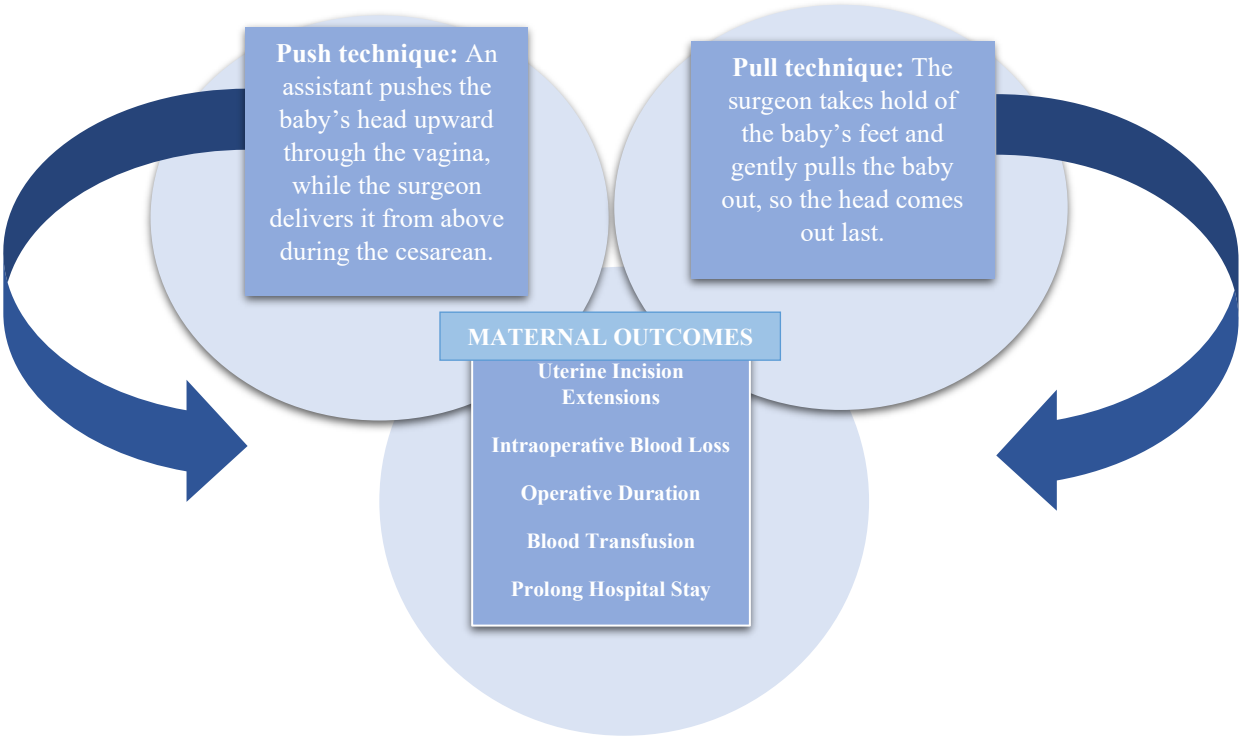

Fig: *Framework to show maternal outcomes using push and pull techniques*

MATERIAL AND METHODS:

Study design:
Randomized controlled trial.

Study Setting:
This study was conducted in the department of Obstetrics & Gynecology, Liaquat University of Medical and Health Sciences Jamshoro, Hyderabad.

Duration of study:
Duration of this study was six months (from August 1st, 2024 to January 31st, 2025)

Sample size:
By taking the prevalence of blood transfusion in pull group i.e. 5% [2], and prevalence of blood transfusion in push group i.e. 25% [2], Power of study = 80%, level of significance = 5%, then the estimated sample n = 49 required in each group. Total sample size was 98 pregnant women.

Sampling technique:
Non-probability consecutive sampling

SAMPLE SELECTION:

Inclusion Criteria:

- All women who required an abdominal delivery by emergency Cesarean Section.
- All women with age between 18 - 45 years.
- Pregnant women with singleton term pregnancy (37–42 weeks), confirmed on ultrasound with cephalic presentation.
- Advanced labor with cervical dilation ≥7 cm with deeply impacted fetal head in maternal pelvis (assessed clinically during C-section).
- Any parity
- Patient who provide informed consent

Exclusion Criteria:

- All women with multiple pregnancy, non-cephalic presentation, previous uterine scar, or gestational age < 37 weeks
- All pregnant women with intrauterine fetal death and congenital fetal anomaly.

Patient who not be willing to provide informed consent

DATA COLLECTION:

This study was conducted after the approval of synopsis from College of Physicians and Surgeons Pakistan. Permission from institutional ethical review committee was taken prior to start of study. All the women who fulfilled the inclusion criteria were admitted for delivery through emergency/OPD in labor room of Department of Obstetrics & Gynecology at Liaquat University of Medical and Health Sciences, Jamshoro, were selected for this study. A written inform consent was taken before operation. Patients were randomly divided into two groups. (Group A) who delivered by reverse breech extraction and (Group B) who delivered by head push method. After detailed history, complete general physical examination were done. Data in terms of maternal age (years), gestational age (weeks), parity, residential status were noted. Reverse breech extraction technique were performed by giving a high transverse incision were set over lower stretched uterine segment where loose fold of visceral peritoneum is attached, at the level of the anterior shoulder of the fetus, as the head were deeply impacted. In the head push technique, an assistant was push the fetal head vaginally while the surgeon was tried to dislodge the head from the pelvis by passing a hand below the head. All caesarean deliveries were performed under spinal anesthesia. The blood loss was estimated by measuring blood by using kidney trays. Maternal outcomes like extension of uterine incision, mean operative time, mean blood loss, blood transfusion and mean hospital stay were assessed in both groups by the researcher and were compared with each other. All the collected information were entered on predesigned Proforma.

DATA ANALYSIS:

Data was entered and analyzed with the help of SPSS version. Shapiro–Wilk test was applied to check the normality of quantitative variables like maternal age, gestational age, parity, mean operative time and blood loss. If data was follow normality (*p*-value > 0.05), mean and standard deviation was calculated otherwise median (range) was reported. Frequency and percentages was calculated for qualitative variable like mode of admission (emergency/OPD), residential status, type of anesthesia and maternal outcome variables i.e. (extension of uterine incision, mean operative time, mean blood loss, blood transfusion and mean hospital stay. Stratification with respect to age, gestational age, parity, mode of admission and residential status was done. Post-stratification, T-test was applied to compare the mean operative time, mean blood loss and mean hospital stay in both groups. Chi-square test was applied to compare extension of uterine incision and blood transfusion between both groups. *P-value* < 0.05 was taken as significant.

RESULTS

A total of 98 pregnant women underwent emergency cesarean section at full dilation for a

deeply impacted fetal head were enrolled in this randomized controlled trial. Participants were equally allocated into two groups: 49 women delivered by the Pull method (reverse breech extraction) and 49 by the Push method (head disimpaction). The study was conducted over a six-month period in the Department of Obstetrics and Gynecology, Liaquat University of Medical and Health Sciences, Jamshoro, Hyderabad. Non-probability consecutive sampling was employed, and data were analyzed using SPSS version 23 to compare maternal outcomes between the two delivery techniques.

Tests of Normality

The Shapiro–Wilk test was applied to assess the normality of quantitative variables. The Shapiro–Wilk test demonstrated that maternal age, gestational age, parity, mean operative time, mean blood loss, and mean hospital stay were all **not normally distributed** ($p < 0.05$). Consequently, non-parametric statistical methods were employed in the comparative analysis of maternal outcomes between the pull and push techniques (Table-1).

Descriptive Statistics

The study comprised 98 women, equally distributed between the *Pull* (n=49, 50.0%) and *Push* (n=49, 50.0%) groups. With respect to clinical characteristics, the majority of participants resided in urban areas (n=58, 59.2%), while a smaller proportion were from rural settings (n=40, 40.8%) (Figure-1). Admission mode was predominantly emergency (n=86, 87.8%), with only twelve cases (12.2%) admitted through the outpatient department, highlighting that most women presented in advanced labor requiring urgent intervention. In terms of anesthetic technique, spinal anesthesia was the preferred method in eighty-eight cases (89.8%), whereas general anesthesia was employed in ten cases (10.2%).

Surgical outcomes revealed that extension of the uterine incision occurred in twenty-eight women (28.6%), while seventy women (71.4%) had no such complication. Blood transfusion was required in twenty-one cases (21.4%), while seventy-seven patients (78.6%) did not necessitate transfusion. A prolonged hospital stay was documented in twenty women (20.4%), whereas the remaining seventy-eight women (79.6%) were discharged within the expected duration (Table-2). The median maternal age was 32 years, with an interquartile range from 25 to 38 years and an overall range of 26 years, indicating that the sample primarily consisted of women in their late twenties to thirties. The median gestational age at the time of cesarean section was 39 weeks, with an interquartile range between 38 and 41 weeks and a total range of 5 weeks, suggesting that most procedures were performed at term. The parity distribution showed a median parity of 2, with an interquartile range from 0 to 3 and a total range of 4, reflecting inclusion of both primiparous and multiparous women.

The median length of hospital stay across the sample was 5.5 days, with an interquartile range of 4 to 7 days and an overall range of 5 days. In terms of operative measures, the median operative time was 48.7 minutes, with an interquartile range of 43.3 to 52.0 minutes and a range of 21.3 minutes, indicating moderate variability in surgical duration. The volume of intraoperative blood loss demonstrated a median of 1296.5 ml, with an interquartile range extending from 1118.5 to 1539.8 ml and a total range of 1228 ml, reflecting that a considerable number of patients experienced high blood loss during the procedure (Table-3).

Stratification

Merged Stratified Tables- (Maternal Age as Confounder)

When stratified by maternal age, the pull method consistently demonstrated superior maternal outcomes compared with the push technique. Among women aged ≥32 years, the pull approach markedly reduced the risk of uterine incision extension (8.0% vs. 47.4%, χ^2=8.92, p=0.003, OR=0.31, 95% CI: 0.12–0.78) and blood transfusion (4.0% vs. 36.8%, χ^2=7.83, p=0.005, OR=0.35, 95% CI: 0.12–0.97). Operative time and intraoperative blood loss were also significantly lower in the pull group (46.9 vs. 51.6 minutes; 1203 vs. 1536 ml, both p<0.001), while hospital stay remained similar across groups.

In contrast, among women younger than 32 years, categorical outcomes such as incision extension and transfusion did not differ significantly between groups (p>0.05). Nevertheless, the pull method continued to provide advantages in operative efficiency and hemostasis, with shorter operative time (49.6 vs. 52.5 minutes) and lower blood loss (1326.5 vs. 1545.5 ml, both p<0.001).
Overall, the Mantel–Haenszel analysis confirmed that, after adjusting for maternal age, the pull method significantly reduced the odds of adverse outcomes—particularly uterine incision extension, transfusion, and prolonged hospital stay. These findings underscore the maternal safety benefits of the pull technique, most notably in women of advanced maternal age (Table-4).

Merged Stratified Tables- (Gestational Age as Confounder)
Stratification by gestational age demonstrated that the pull method consistently yielded better maternal outcomes compared to the push method. Uterine incision extension was significantly lower with the pull technique at higher gestational ages (10.5% vs. 37.9%, p=0.037), with a similar trend at lower gestational ages (20.0% vs. 45.0%, p=0.059). The pooled Mantel–Haenszel odds ratio confirmed a strong protective effect (OR=0.25, 95% CI: 0.09–0.68, p=0.006) without evidence of effect modification.
For blood transfusion, a significant benefit of the pull method was observed at lower gestational ages (13.3% vs. 45.0%, p=0.012), while pooled analysis again supported a protective effect (OR=0.27, 95% CI: 0.09–0.79, p=0.017).
Continuous outcomes further reinforced these results: operative time and intraoperative blood loss were significantly reduced in the pull group across both gestational age strata (p<0.001), whereas hospital stay length remained comparable. Collectively, these findings highlight the consistent superiority of the pull method in improving maternal outcomes irrespective of gestational age (Table-5).

Merged Stratified Tables- (Parity as Confounder)
Stratified analysis by parity showed that uterine incision extension was lower in the Pull group across both high (18.8% vs 50.0%, OR=0.28, p=0.063) and low parity (15.2% vs 36.4%, OR≈0.31, p=0.049) strata, with a pooled Mantel–Haenszel OR=0.28 (95% CI 0.11–0.72, p=0.009). Blood transfusion was also consistently reduced in the Pull group (high parity 18.8% vs 43.8%, low parity 9.1% vs 24.2%), and the combined OR=0.31 (95% CI 0.10–0.88, p=0.029). Operative time and blood loss were significantly lower in the Pull group in both strata (p<0.001). Hospital stay did not differ significantly within strata, but pooled analysis indicated a protective effect of the Pull method (OR=0.27, 95% CI 0.09–0.80, p=0.019). Homogeneity tests were non-significant, indicating no effect modification by parity. Thus, parity did not act as a major confounder, and the superiority of the Pull method remained consistent and robust across strata (Table-6).

Merged Stratified Tables- (Residential Status as Confounder)
Stratified analysis revealed that uterine incision extension was significantly higher in the Push group compared to the Pull group in rural patients (χ^2 = 8.976, p = 0.003; Fisher's exact p = 0.004), while no significant difference was observed in the urban subgroup (χ^2 = 1.071, p = 0.301). However, the Mantel–Haenszel pooled analysis demonstrated a significant protective effect of the Pull method (OR = 0.289, 95% CI: 0.113–0.742, p = 0.010). The Breslow–Day test suggested borderline heterogeneity between strata (p = 0.064), indicating some confounding effect of residential status.
A similar pattern was observed for blood transfusion. In rural patients, transfusion was significantly more frequent in the Push group (χ^2 = 6.166, p = 0.013), while the urban group showed no significant association (p = 0.434). The pooled Mantel–Haenszel odds ratio confirmed the protective effect of the Pull method (OR = 0.323, 95% CI: 0.114–0.914, p = 0.033), with no evidence of heterogeneity (p = 0.127). For operative time and blood loss, Pull consistently

resulted in significantly lower values across both rural and urban subsets ($p < 0.001$). In contrast, hospital stay showed no significant difference between Pull and Push in either stratum, which was supported by percentile analysis (Table-7).

Merged Stratified Tables- (Mode of Admission as Confounder)

Stratified analysis revealed that after adjusting for mode of admission (Emergency vs. OPD), the Pull technique consistently showed better maternal outcomes compared to the Push method. In emergency cases, uterine incision extension was significantly higher in the Push group, while the Pull method showed a protective effect, confirmed by the pooled Mantel–Haenszel odds ratio (OR = 0.29, 95% CI: 0.11–0.75, $p = 0.011$). A similar pattern was observed for blood transfusion, where Pull reduced the overall risk (OR = 0.33, 95% CI: 0.11–0.93, $p = 0.036$). Operative outcomes also favored Pull, with significantly shorter operative time and lower intraoperative blood loss across both emergency and OPD strata. Hospital stays, however, did not differ between groups. Overall, the Pull method emerged as the safer and more efficient technique, offering consistent protection against adverse maternal outcomes irrespective of admission type (Table-8).

Merged Stratified Tables- (Anesthesia type as Confounder)

Stratified analysis by anesthesia type showed clear maternal benefits of the Pull method over Push. Under spinal anesthesia, Pull markedly lowered uterine incision extension (17.8% vs. 39.5%) with a pooled odds ratio of 0.28 ($p = 0.009$), while under general anesthesia, a similar trend was seen but was not statistically significant due to small numbers. Blood transfusion followed the same pattern, with Pull reducing the requirement significantly in spinal cases (13.3% vs. 34.9%, OR = 0.29, $p = 0.022$), whereas no meaningful comparison could be made under general anesthesia.

Operative outcomes further supported Pull, as it significantly shortened operative time and reduced blood loss in spinal cases, with similar though less conclusive trends under general anesthesia. Hospital stays, however, remained unaffected in both strata. Overall, Pull consistently improved intraoperative maternal outcomes, especially under spinal anesthesia, though evidence under general anesthesia was limited by sample size (Table-9).

Interferential Statistics

The Chi-square test was applied to analyze categorical variables for comparing outcomes between the Push and Pull groups. The analysis indicates that residential status, mode of admission, and type of anesthesia were not significantly associated with the choice of delivery method (Pull vs. Push), showing no meaningful difference between the groups. However, extension of uterine incision, need for blood transfusion, and prolonged hospital stay occurred significantly more often in the Push group compared with the Pull group (Figure: 2-3). These findings suggest that the Pull method is comparatively safer and more beneficial, as it is associated with fewer complications and shorter hospital stays (Table-9).

The Mann–Whitney U test was applied to compare maternal outcomes between the Pull and Push groups, given the non-normal distribution of data.

The results revealed **no significant differences** in maternal age, parity, or hospital stay between the two groups. Gestational age showed a borderline trend ($p = 0.064$), with slightly higher ranks in the Push group, but this did not reach statistical significance.

In contrast, **operative time and blood loss were markedly higher in the Push group** compared with the Pull group ($p < 0.001$ for both), indicating that the Pull technique substantially reduced surgical duration and intraoperative blood loss (Figure: 4-5). These findings highlight the procedural advantage of the Pull method in terms of efficiency and maternal safety (Table-10).

Tables

Table-1: Shapiro–Wilk Test of Normality

Variables	Statistics	df	Sig. (*p*-value)
Maternal Age (years)	0.950	98	0.001
Gestational Age (weeks)	0.902	98	0.000
Parity	0.879	98	0.000
Mean Operative Time (min)	0.962	98	0.006
Mean Blood Loss (ml)	0.953	98	0.001
Mean Hospital Stay (days)	0.889	98	0.000

Table-2: ***Descriptive Statistics of Categorical Data***

Categorical Data	Variables	N (%)
Group	Pull	49 (50%)
	Push	49 (50%)
Residential Status	Rural	40 (40.8%)
	Urban	58 (59.2%)
Mode of Admission	Emergency	86 (87.8%)
	OPD	12 (12.2%)
Type of Anesthesia	Spinal	88 (89.8%)
	General	10 (10.2%)
Extension of Uterine Incision	Yes	28 (28.6%)
	No	70 (71.4%)
Blood Transfusion	Yes	21 (21.4%)
	No	77 (78.6%)
Prolong Hospital Stay	Yes	20 (20.4%)
	No	78 (79.6%)

Table 3: ***Descriptive Statistics of Continuous Data***

Continuous Data	Median	(IQR / Range)
Maternal Age (years)	32	(IQR: 25–38, Range: 26)
Gestational Age (weeks)	39	(IQR: 38–41, Range: 5)
Parity	2	(IQR: 0–3, Range: 4)
Operative Time (min)	48.7	(IQR: 43.3–52.0, Range: 21.3)
Blood Loss (ml)	1296.5	(IQR: 1118.5–1539.8, Range: 1228)
Hospital Stay (days)	5.5	(IQR: 4–7, Range: 5)

Table 4: ***Maternal Outcomes by Age Category and Delivery Method***

(a) Categorical Outcomes

Maternal Age	Outcome	Pull (%)	Push (%)	χ^2 / OR (95% CI)	*p*-value
≥ 32 yrs	Uterine incision extension	8.0	47.4	χ^2=8.92, OR=0.31 (0.12–0.78)	0.003

(a) Categorical Outcomes					
Maternal Age	**Outcome**	**Pull (%)**	**Push (%)**	**χ^2 / OR (95% CI)**	***p*-value**
< 32 yrs	Blood transfusion	4.0	36.8	χ^2=7.83, OR=0.35 (0.12–0.97)	0.005
	Prolonged stay	–	–	OR=0.27 (0.09–0.80)	0.019
	Uterine incision extension	25.0	36.7	χ^2=0.84, NS	>0.05
	Blood transfusion	20.8	26.7	χ^2=0.25, NS	>0.05
	Prolonged stay	–	–	NS	>0.05
(b) Continuous Outcomes					
Maternal Age	**Outcome**	**Pull (Median)**	**Push (Median)**	**U / Z**	***p*-value**
≥ 32 yrs	Operative time (min)	46.9	51.6	U=7.00, Z=–5.46	<0.001
	Blood loss (ml)	1203	1536	U=40.0, Z=–4.68	<0.001
	Hospital stays (days)	5	5	U=217.5, Z=–0.48	NS
< 32 yrs	Operative time (min)	49.6	52.5	U=3.50, Z=–6.21	<0.001
	Blood loss (ml)	1326.5	1545.5	U=75.0, Z=–4.96	<0.001
	Hospital stays (days)	6	7	U=340.0, Z=–0.36	NS

Table 5: ***Maternal Outcomes by Gestational Age and Delivery Method***

Outcome	Gestational Age	Pull (%)/ Median	Push (%)/ Median	χ^2 / U (Z)	*p*-value	OR (95% CI)
Uterine incision extension	High	10.5%	37.9%	χ^2=4.37	0.037*	0.25 (0.09–0.68)
	Low	20.0%	45.0%	χ^2=3.57	0.059	
Blood transfusion	High	10.5%	20.7%	χ^2=0.85	0.356	0.27 (0.09–0.79)
	Low	13.3%	45.0%	χ^2=6.25	0.012*	
Operative time (min)	High	49.5	52.4	Z=-5.81	<0.001*	–
	Low	47.6	51.3	Z=-5.71	<0.001*	–
Blood loss (ml)	High	1336	1634	Z=-4.33	<0.001*	–
	Low	1199	1429	Z=-5.33	<0.001*	–
Hospital stays (days)	High	6	6	Z=-0.44	0.659	–
	Low	M5	5	Z=-0.46	0.643	–

Outcome	Gestational Age	Pull (%)/ Median	Push (%)/ Median	χ^2 / U (Z)	*p*-value	OR (95% CI)

Table 6: *Maternal Outcomes by Parity and Delivery Method*

Outcome	Parity Stratum	Pull	Push	χ^2 / U Test (*p*-value)	OR (95% CI)	Mantel–Haenszel OR (*p*-value)
Uterine Incision Extension	High parity (n=32)	18.8%	50.0%	χ^2=3.46 *p*=0.063	OR=0.28 (0.11–0.73)	OR=0.28 (0.11–0.72), *p*=0.009
	Low parity (n=66)	15.2%	36.4%	χ^2=3.88 *p*=0.049	OR≈0.31 (0.12–0.80)	
Blood Transfusion	High parity (n=32)	18.8%	43.8%	χ^2=2.33 *p*=0.127	OR≈0.30 (0.10–0.88)	OR=0.31 (0.10–0.88), *p*=0.029
	Low parity (n=66)	9.1%	24.2%	χ^2=2.72 *p*=0.099	OR≈0.35 (0.12–0.97)	
Operative Time (median)	High parity (n=32)	47.6 min	52.0 min	U=1.0, Z=-4.79, *p*<0.001	–	Consistently shorter in Pull group
	Low parity (n=66)	49.0 min	52.5 min	U=11.0, Z=-6.84, *p*<0.001	–	
Blood Loss (median)	High parity (n=32)	1314 ml	1614 ml	U=17.0, Z=-4.18, *p*<0.001	–	Consistently lower in Pull group
	Low parity (n=66)	1198 ml	1534 ml	U=120.0, Z=-5.44, *p*<0.001	–	
Hospital Stays (median)	High parity (n=32)	5.5 days	5.5 days	U=122.5, Z=-0.21, *p*=0.832	–	Common OR for prolonged stay=0.27 (95% CI 0.09–0.80), *p*=0.019
	Low parity (n=66)	6.0 days	7.0 days	U=483.0, Z=-0.80, *p*=0.423	–	

Table 7: *Maternal Outcomes by Residential Status and Delivery Method*

Outcome	Rural (*p*-value / OR)	Urban (*p*-value / OR)	Mantel–Haenszel Common OR (95% CI)	Interpretation
Uterine incision Extension	Significant (p = 0.003, Push risk ↑)	Non-significant (p = 0.301)	OR = 0.289 (0.113–0.742), p = 0.010	Pull reduces risk; rural effect stronger
Blood transfusion	Significant (p = 0.013, Push risk ↑)	Non-significant (p = 0.434)	OR = 0.323 (0.114–0.914), p = 0.033	Pull reduces transfusion; effect consistent
Operative time	Significant (p < 0.001, shorter in Pull)	Significant (p < 0.001)	–	Pull lowers operative time in both strata
Blood loss	Significant (p < 0.001, lower in Pull)	Significant (p < 0.001)	–	Pull lowers blood loss in both strata

Outcome	Rural (*p*-value / OR)	Urban (*p*-value / OR)	Mantel–Haenszel Common OR (95% CI)	Interpretation
Hospital stays	Non-significant (p = 0.289)	Non-significant (p = 0.077)	–	No effect of method on hospital stays

Table 8: *Maternal Outcomes by Admission mode and Delivery Method*

Outcome	Mode of Admission	Pull (%)	Push (%)	Test / Statistic	p-value	Mantel–Haenszel
Extension of Uterine Incision	Emergency (n=86)	19.0%	40.9%	χ^2=4.87	0.027	0.29 (0.11–0.75), p=0.011
	OPD (n=12)	0%	40.0%	χ^2=3.36	0.067	
	Pooled	–	–	Breslow-Day p=0.255	NS (homogeneous)	Pull protective
Blood Transfusion	Emergency (n=86)	14.3%	31.8%	χ^2=3.70	0.054	0.33 (0.11–0.93), p=0.036
	OPD (n=12)	0%	20%	χ^2=1.53	0.217	
	Pooled	–	–	Breslow-Day p=0.449	NS (homogeneous)	Pull protective
Operative Time (median/IQR)	Emergency	Pull: 43.3 (41–47) min	Push: 48.8 (47–52) min	Mann–Whitney Z=–7.86	<0.001	–
	OPD	Pull: 42.6 (41–47) min	Push: 47.3 (45–50) min	Mann–Whitney Z=–2.60	0.009	–
Blood Loss (median/IQR)	Emergency	Pull: 1117 (1000–1400) ml	Push: 1309 (1150–1550) ml	Mann–Whitney Z=–6.32	<0.001	–
	OPD	Pull: 1159 (1050–1350) ml	Push: 1242 (1150–1450) ml	Mann–Whitney Z=–2.52	0.012	–
Hospital Stay (median/IQR)	Emergency	Pull: 5 (4–7) days	Push: 5 (4–7) days	Z=–0.58	0.562	–
	OPD	Pull: 6 (4–7) days	Push: 7 (5–7) days	Z=–0.66	0.510	–

Table 9: *Maternal Outcomes by Anesthesia type and Delivery Method*

Table 10: ***Comparative Association of Maternal Outcomes Between Pull and Push Techniques***

(a) Categorical Outcome						
Maternal Outcome	**Anesthesia**	**Group**	**Yes n (%)**	**No n (%)**	**Test Result**	**Mantel–Haenszel**
Uterine Incision Extension	Spinal (n=88)	Pull: 8 (17.8%) Push: 17 (39.5%)	Pull: 37 (82.2%) Push: 26 (60.5%)	χ^2 = 7.20, p = 0.007 MH χ^2 = 5.92, p = 0.015	0.28 (0.11–0.73)	0.009
	General (n=10)	Pull: 0 (0%) Push: 3 (50%)	Pull: 4 (100%) Push: 3 (50%)	χ^2 = 2.86, p = 0.091 (NS)	–	–
Blood Transfusion	Spinal (n=88)	Pull: 6 (13.3%) Push: 15 (34.9%)	Pull: 39 (86.7%) Push: 28 (65.1%)	χ^2 = 5.62, p = 0.018 MH χ^2 = 4.45, p = 0.035	0.29 (0.10–0.83)	0.022
	General (n=10)	Pull: 0 (0%) Push: 0 (0%)	Pull: 4 (100%) Push: 6 (100%)	Constant (no variation)	–	–
(b) Continuous Outcome						
Outcome	**Anesthesia**	**Pull (Median)**	**Push (Median)**	**Mann–Whitney Z**	***p*- value**	
Operative Time (min)	Spinal	Pull: 43.4	Push: 48.0	Z = –7.95	$p < 0.001$	
	General	Pull: 41.6	Push: 51.0	Z = –2.35	$p = 0.019$	
Blood Loss (ml)	Spinal	Pull: 1122	Push: 1314	Z = –6.71	$p < 0.001$	
	General	Pull: 1097	Push: 1197	Z = –1.92	$p = 0.055$ (NS)	
Hospital Stays (days)	Spinal	Pull: 5.0	Push: 5.5	Z = –0.93	$p = 0.351$ (NS)	
	General	Pull: 5.5	Push: 5.5	Z = –0.67	$p = 0.502$ (NS)	

Variable	χ^2 Value	*p*-value	Significant	Association Direction
Residential Status (Rural/Urban)	0.169	0.681	No	No difference
Mode of Admission (Emergency/OPD)	0.380	0.538	No	No difference
Type of Anesthesia (Spinal/Gen)	0.445	0.505	No	No difference
Extension of Uterine Incision	7.200	0.007	Yes	Less in Pull group
Blood Transfusion	4.909	0.027	Yes	Less in Pull group
Prolonged Stay	6.282	0.012	Yes	Less in Pull group

Table 11: ***Comparison of Maternal Outcomes Between Pull and Push Groups Using Mann–Whitney U Test***

Variable	(Pull)	(Push)	U Value	Z Value	p-value	Significant
Maternal Age (years)	53.27	45.73	1016.0	-1.312	0.189	No
Gestational Age (weeks)	44.27	54.73	944.0	-1.853	0.064	Borderline (NS)
Parity	49.60	49.40	1196.0	-0.037	0.971	No

Variable	(Pull)	(Push)	U Value	Z Value	p-value	Significant
Operative Time (min)	25.52	73.48	25.5	-8.350	**<0.001**	Yes
Blood Loss (ml)	29.86	69.14	238.0	-6.839	**<0.001**	Yes
Hospital Stay (days)	47.41	51.59	1098.0	-0.740	0.459	No

Figures

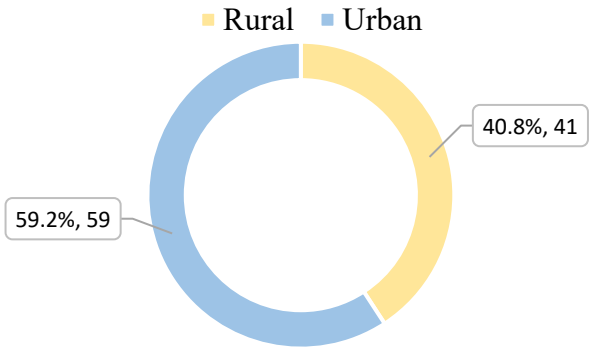

Figure 1: *Distribution of Residential Status*

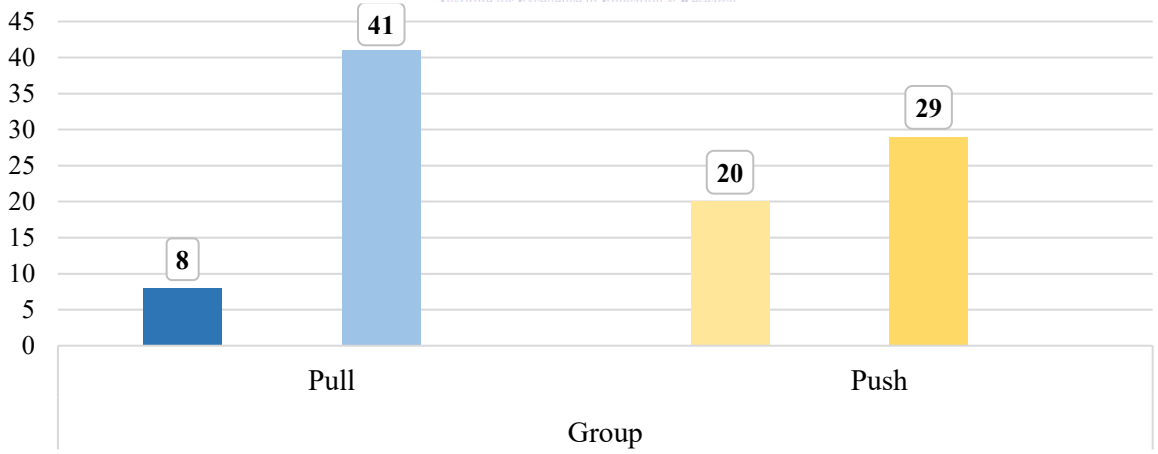

Figure 2- *Comparative Association of Uterine incision extension Between Pull and Push Techniques*

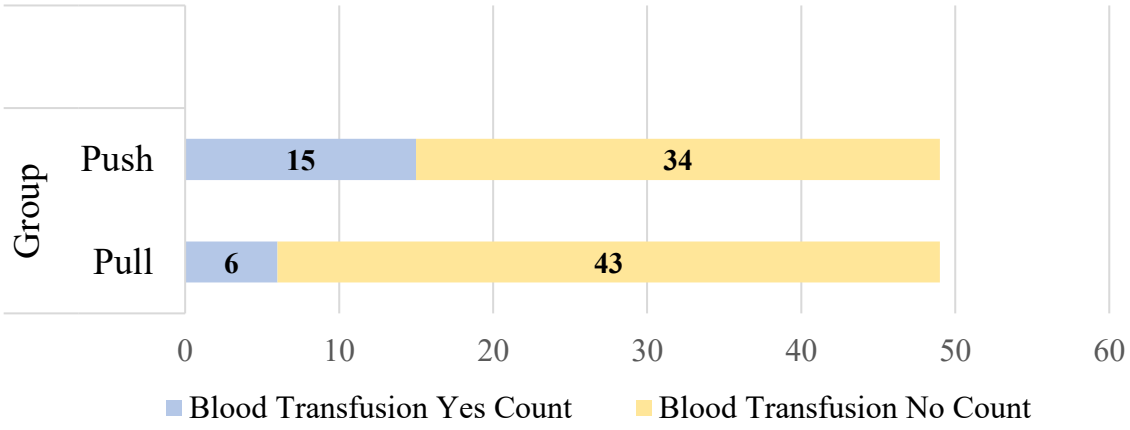

Figure-3: *Comparative Association of Blood Transfusion Between Push and Pull Techniques*

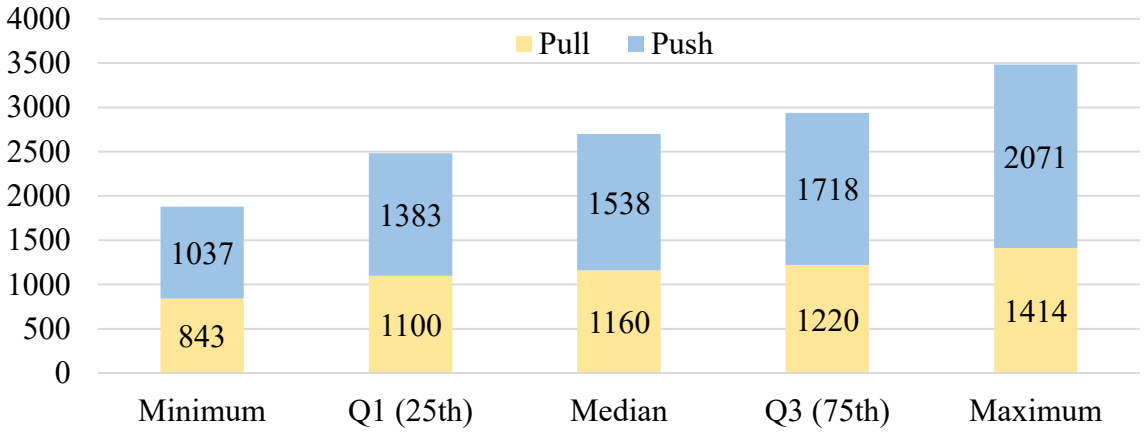

Figure-4: *Comparison of Blood Loss (ml) Between Pull and Push Groups*

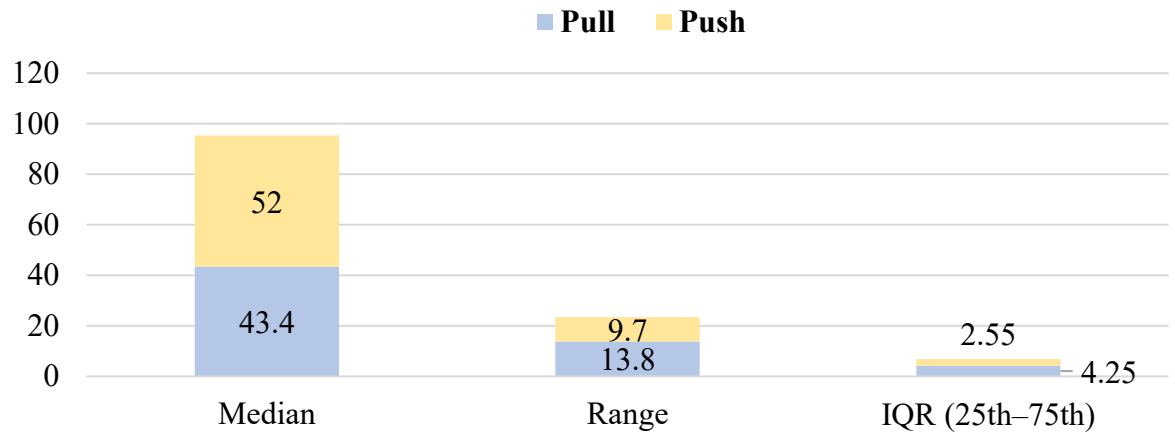

Figure-5: *Comparison of Operative time (min) Between Pull and Push Groups*

DISCUSSION

The present randomized controlled trial compared the Pull (reverse breech extraction) and Push (head disimpaction) methods for delivering a deeply impacted fetal head during cesarean section at full dilatation. Our findings demonstrate that the Pull method was consistently associated with improved maternal outcomes, including significantly lower rates of uterine incision extension, reduced intraoperative blood loss, shorter operative time, and decreased need for blood transfusion, while length of hospital stay remained largely comparable between groups. These benefits were observed across different maternal and clinical subgroups such as age, gestational age, parity, residential status, and anesthesia type, with the protective effect of Pull most evident among women of advanced maternal age, higher gestational age, and those operated under spinal anesthesia. Collectively, these results reinforce the growing body of evidence that alternative techniques to the traditional Push method can offer substantial maternal safety advantages, and they provide important insight into improving clinical practice in both high- and low-resource obstetric settings.

The reduction in uterine incision extension seen with the Pull method in our trial is consistent with earlier published evidence. In particular, the findings align with a meta-analysis highlighted in *Scientific Impact Paper No. 73*, which demonstrated a substantially higher risk of extension when using the Push technique (RR 3.45, 95% CI: 2.41–4.93). [17] This agreement between our results and previous research strengthens the argument that the Pull method is not only safer but also more reliable in minimizing maternal complications during cesarean delivery for impacted fetal head.

Similarly, Peled et al. (2023), in a large multicenter study, reported that reverse breech extraction was associated with fewer uterine incision extensions compared with the Push technique, further corroborating our findings. However, they noted that long-term follow-up revealed no significant differences in preterm birth rates between the two groups. Taken together, these data reinforce that the Pull method provides clear maternal protection against surgical trauma, even though neonatal outcomes may remain unaffected in the longer term. [18]

Blood transfusion requirements were also notably lower in the Pull group in our study. This observation is in line with findings from previous systematic reviews, which reported that the Push technique carries nearly a threefold higher risk of transfusion (RR 2.75, 95% CI: 1.55–4.88). These results suggest that the reduced surgical trauma associated with the Pull method not only minimizes the likelihood of uterine incision extension but also translates into a lower risk of significant blood loss, further emphasizing its maternal safety advantage. [17]

These findings are consistent with the work of Lal et al. (2018), who demonstrated that alternative

disimpaction techniques, such as the Patwardhan method, were also associated with fewer cases of uterine incision extension and reduced transfusion needs compared with the Push approach. Our randomized data therefore add to this growing body of evidence by confirming that techniques which avoid exerting upward pressure on the fetal head, such as the Pull method, offer superior hemostatic outcomes and greater maternal safety. [19]

Efficiency emerged as another important advantage of the Pull technique. In our study, operative duration was significantly shorter and intraoperative blood loss considerably lower in the Pull group. These results are consistent with several individual trials, summarized in recent meta-analyses (e.g., Fasubaa, Frass, Nooh, Saleh, Tahir, Veisi), which consistently found that the Push method was associated with longer procedures and greater hemorrhage. The efficiency gains observed with Pull may contribute to smoother intraoperative management and are particularly valuable in resource-limited settings, where extended surgical time and blood loss can substantially increase maternal risk. [17]

Interestingly, our study did not demonstrate a significant difference in hospital stay between the Pull and Push groups. This finding mirrors earlier research, which similarly reported minimal variation in length of stay. However, prior studies have noted that maternal morbidity including endometritis, wound infection, and sepsis tended to occur more frequently following the Push technique. This suggests that while overall hospitalization time may remain comparable, the quality of postoperative recovery could be more favorable with Pull due to its association with fewer infectious complications. [17] By contrast, a retrospective study conducted at Ipswich Hospital evaluating the use of the fetal pillow reported a modest but significant reduction in hospital stay (−9.4 hours, $P = 0.029$), together with improved neonatal outcomes, including higher arterial pH values. These findings highlight that while our trial did not identify differences in admission duration between Pull and Push, adjunctive measures such as fetal pillow use may influence both maternal recovery and neonatal well-being. [20]

Similarly, a meta-analysis of fetal head elevation devices (FHED) reported significant benefits, including reductions in uterine incision extensions, transfusion requirements, operative complications, and mean blood loss (ORs 0.39–0.50; mean difference in blood loss −130.82 mL, $p < 0.001$), alongside shorter hysterotomy-to-delivery intervals. Although the nature of these interventions differs from reverse breech extraction, both our trial and FHED studies underscore the same principle: techniques that facilitate disimpaction whether surgically or with device assistance can substantially enhance maternal safety. [21]

The findings from our trial contribute novel evidence by directly comparing two surgical techniques, rather than device-based methods. We demonstrated that the Pull approach significantly reduced uterine incision extensions and transfusion requirements maternal outcomes that have not been consistently improved in FHED studies. Nevertheless, the agreement between surgical and device-assisted approaches highlights a central principle: minimizing the mechanical difficulty of delivering an impacted head is key to improving outcomes. This interpretation is further supported by Cornthwaite et al. (2021), who validated a birth simulator for impacted fetal head and demonstrated its usefulness in rehearsing multiple disimpaction techniques, including reverse breech extraction, thereby underscoring the importance of structured training for the safe and effective application of the Pull method. [22]

Real-world practice patterns further frame the significance of our findings. In a prospective study of 440 emergency cesarean sections, Rice et al. (2019) reported difficulty in delivering the fetal head in 18% of cases—most often at dilatations of 8 cm or greater—and observed a 36% increase in maternal blood loss in these cases, all of which were managed using the Push technique. This illustrates the continued reliance on Push in clinical practice, despite its associated risks. By contrast, our trial demonstrates that the Pull method substantially reduces both blood loss and

operative time, underscoring the importance of translating emerging evidence into practice and adopting safer surgical alternatives. [23]

The global perspective further reinforces the importance of our findings. Ragbourne (2023) reported that impacted fetal head occurs with an incidence ranging from 2.9% to 71.8%, most frequently at full dilatation or in the context of oxytocin augmentation, and is linked to serious maternal complications such as postpartum hemorrhage and bladder injury. Against this backdrop, our demonstration that the Pull method significantly reduces hemorrhage and incision extensions provides direct and clinically relevant evidence to address these global concerns. [8]

Waniala et al. (2022) highlighted persistent disparities in cesarean outcomes between rural and urban facilities in Uganda, with rural centers facing higher risks largely due to limited expertise and resources. In line with this, our stratified analysis demonstrated that the Pull technique was particularly advantageous among rural women, underscoring its value as a simple, low-cost, and practical intervention in resource-constrained settings where safer alternatives are most urgently needed. [24]

From a wider perspective, Ngongo et al. reviewed 4,396 women with obstetric fistula in East and Central Africa and reported that the majority (84.1%) experienced stillbirths, often as a result of obstructed labor, with cesarean delivery frequently undertaken even in cases of intrauterine fetal death. Their work underscores the long-term risks of unnecessary cesarean sections, particularly those related to uterine scarring and subsequent complications. Our study complements these insights by demonstrating that when cesarean delivery is unavoidable for impacted fetal head, the surgical approach matters: adopting the Pull method can reduce immediate maternal morbidity and may help mitigate future scar-related risks. [25]

At a broader level, our clinical findings also connect with the evolutionary perspective described by Pavličev et al. (2020). They explained that the shape of the human pelvis represents a compromise between upright walking and the demands of childbirth, which makes women more prone to obstructed labor and impacted fetal head. Our trial offers practical evidence that surgical innovations such as the Pull method can help overcome these natural challenges and improve maternal outcomes. [26]

Finally, evidence from systematic reviews further supports our results. In a meta-analysis of 19 studies involving 2,345 women, Rada et al. (2021) concluded that the Pull and Patwardhan techniques were safer than Push, being associated with fewer maternal complications. Our randomized trial strengthens this body of evidence by moving beyond observational data and offering stronger causal inference, thereby reinforcing the case for Pull as a safer surgical approach. [10]

Moreover, the global increase in cesarean section rates projected by the WHO to reach 28.5% of all births by 2030 makes the need to optimize intraoperative safety more pressing than ever. [27] Wider adoption of safer techniques such as the Pull method has the potential to significantly reduce preventable maternal morbidity on a global scale.

Conclusion

Our study adds to the growing body of evidence highlighting the advantages of the Pull method over the traditional Push technique in managing deeply impacted fetal head during cesarean section. By significantly reducing maternal blood loss, operative time, and uterine incision extensions, Pull not only enhances immediate surgical safety but also holds promise for reducing long-term complications. Its particular benefit in rural and resource-limited settings further underscores its practicality as a low-cost, effective intervention. In the context of rising global cesarean rates, the adoption of safer techniques such as Pull is both timely and essential. Future research should continue to refine surgical strategies while promoting widespread training and implementation to improve maternal outcomes worldwide.

Recommendations

- **Adopt Pull as the preferred method**: Clinical practice should increasingly favor the Pull (reverse breech extraction) technique over

Push for deeply impacted fetal head at full dilatation, given it demonstrated maternal safety benefits.

- **Structured training programs**: Obstetricians, particularly trainees and rural practitioners, should receive simulation-based and hands-on training in the Pull technique to ensure safe and confident execution.
- **Integration into guidelines**: National and international obstetric societies should incorporate Pull into clinical guidelines and teaching curricula as a standard option for impacted fetal head.
- **Resource-limited settings**: Hospitals in low-resource and rural areas should prioritize Pull because it is a low-cost, practical technique that does not require specialized devices.
- **Audit and feedback**: Regular monitoring of cesarean outcomes should be encouraged to track the impact of Pull adoption on maternal morbidity and refine practice further.

Limitations of the Study

- **Single-center design**: Findings are limited to one institution and may not fully reflect variations in other healthcare settings.
- **Short-term outcomes only**: The study did not assess long-term maternal or neonatal outcomes (e.g., future pregnancies, scar integrity, neonatal development).
- **Sample size**: Although adequate for detecting key outcomes, larger multicenter trials would provide stronger generalizability.
- **Neonatal outcomes**: The trial primarily focused on maternal safety, so neonatal outcomes beyond immediate birth data were not comprehensively assessed.
- **Exclusion criteria**: Women with certain obstetric complications were excluded, which may limit applicability to all cesarean populations.

Future Scope

- **Multicenter RCTs**: Large-scale, multicountry randomized controlled trials should be conducted to validate these findings across diverse healthcare systems.
- **Long-term follow-up**: Future research should evaluate maternal outcomes such as scar integrity, fertility, and risks in subsequent pregnancies.
- **Neonatal outcomes**: More detailed assessment of neonatal morbidity and long-term development following Pull versus Push is needed.
- **Comparative studies with devices**: Direct comparisons of Pull against fetal pillow and other head elevation devices would clarify relative safety and efficiency.
- **Cost-effectiveness analysis**: Economic evaluations could help quantify the financial benefits of Pull, particularly for resource-constrained health systems.
- **Training research**: Studies assessing simulation models and structured training programs for Pull could inform how best to scale up its safe adoption.
- **Guideline development**: Evidence synthesis from trials like this should feed into revisions of international obstetric guidelines to standardize practice.

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AUTHOR'S CONTRIBUTION:

Collection and acquisition of data & grammatical corrections	*Dr. Ujala Naz*
Concept & design of study & proof read	*Dr. Najma Bano Shaikh*

Drafting the article and finalizing the manuscript	*Dr. Kanwal*
Final Approval of version	*By All Authors*

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