BMC Pregnancy and Childbirth

RESEARCH

Open Access

Striking a balance between aesthetics and safety: a comparative study on the maternal and neonatal outcomes of mini-incision cesarean section

ChunLan Yuan[1†], ShiMei He[1†], WenQian Jian[1†], MeiRong He[1], HuiFang Huang[1], JianChun Huang[1*], MeiPing He[1*] and KaiSun Zhao[1*]

Abstract

Objective and significance The pursuit of aesthetic outcomes is a natural tendency for individuals, particularly for women undergoing cesarean sections, who seek to minimize abdominal scarring. The aim of this study is to compare the risks and outcomes of mini-incision cesarean sections with those of conventional incision cesarean sections.

Methods A total of 99 pregnant women with full-term singleton pregnancies, who delivered at the Second Nanning People's Hospital from January 2024 to September 2024, were enrolled in this study. The participants were stratified into two groups: the mini-incision group ($n=33$) and the conventional incision group ($n=66$). The study evaluated several variables, including the time from incision to fetal delivery (I-D), surgery duration, intraoperative blood loss, duration of postoperative antibiotic administration, post-operative hospitalization duration, incidence of wound infection, neonatal adverse outcomes, and blood routine parameters.

Results The surgery duration in the mini-incision group was significantly shorter than that in the conventional group. Furthermore, the rate of forceps-assisted delivery was significantly higher in the mini-incision group ($P<0.05$ for both comparisons). However, no statistically significant differences were observed between the two groups in terms of intraoperative blood loss or maternal and neonatal outcomes, including neonatal complications, incidence of wound infection, and other maternal outcomes.

Conclusion Our findings indicate that when a pregnant woman requests a mini-incision cesarean section, the procedure can be safely performed by an experienced obstetrician proficient in forceps-assisted delivery techniques, provided it is not categorized as a Category I cesarean section.

Keywords Cesarean section, Mini-incision, Forceps assistance, Surgery duration

†ChunLan Yuan, ShiMei He and WenQian Jian contributed equally to this work and are both first authors.

*Correspondence:
JianChun Huang
huangjc3081@163.com
MeiPing He
hemp7799@163.com
KaiSun Zhao
339609234@qq.com
Full list of author information is available at the end of the article

Introduction

Cesarean section is a prevalent and vital procedure in obstetrics, primarily used for managing dystocia and high-risk pregnancies. As the cesarean section rate increases, patients' concerns about the aesthetics and recovery associated with surgical incisions have also grown. While specific recent data on patient preferences for surgical aesthetics in cesarean deliveries is limited, it is widely recognized that aesthetic considerations are important to many patients, reflecting a natural human desire for body image and self-esteem. Therefore, studying the safety and effectiveness of different incision techniques is crucial for optimizing clinical practice. Despite its prevalence, there is limited data on the optimal incision techniques for cesarean sections. However, for term cesarean sections, most experts recommend an incision length of approximately 15 cm. Research indicates that the median incision length for cesarean sections typically measures around 15 cm [1]. Previous research has confirmed that longer incisions are a risk factor for post-operative surgical site infections [2], and the length of the skin incision is closely associated with post-operative inflammatory responses [3]. Additionally, longer incisions can increase the likelihood of wound complications [4]. Mini-incision cesarean sections may offer significant advantages in reducing post-operative complications, shortening recovery time, and improving patient satisfaction, which are critical issues in contemporary obstetric care. While some mothers view the cesarean scar as a "badge of honor," others may perceive it as an unsightly "centipede line." For women who value aesthetics, a cesarean scar is not a welcome addition, and to restore the abdomen to its original state, attention must be given to incision and scar care. Women predisposed to abnormal scarring, particularly after cesarean sections, face an elevated risk of developing hypertrophic scars that can progress to keloids. Hypertrophic scars and keloids are fibroproliferative disorders caused by abnormal wound healing in susceptible individuals following trauma, inflammation, surgery, or burns. Hypertrophic scars do not extend beyond the original wound edges, whereas keloids continue to grow beyond the original wound boundaries, invading adjacent healthy skin [5]. Keloids often cause pain and itching, affecting aesthetics, function, and quality of life, and they have a significant tendency to recur even after surgical excision. The risk of keloid formation seems to be highest among individuals of African or Asian descent, being nearly three times and 2.5 times that of non-Hispanic whites, respectively [6]. High-quality data on the prevalence and incidence of keloids is scarce. Based on data from the Taiwan National Health Insurance Research Database, the annual incidence of keloids is estimated to be 0.15% [7]. This study aims to compare mini-incision cesarean sections with conventional incisions in terms of maternal and neonatal outcomes, hypothesizing that mini-incision cesarean sections can provide similar safety as conventional incisions while offering advantages in aesthetics and recovery. Although previous studies have explored different techniques for cesarean incisions, systematic evaluations of mini-incision cesarean sections remain scarce, and further research is needed to fill this gap. Recently, the Dermabond-Prineo Skin Closure System (DP) has gained attention for its effectiveness in various surgical procedures. Studies have shown that the DP system offers certain advantages in terms of post-operative complications, costs, and aesthetic outcomes [8]. We utilized a Pfannenstiel incision in our study, aiming to analyze the differences in maternal and neonatal outcomes between smaller and conventional incisions. This research seeks to provide a theoretical basis for the clinical application of smaller incisions.

Patients and methods

General information

This study focuses on pregnant women who delivered at the Second Nanning People's Hospital from January 2024 to September 2024. The participants included those who underwent non-Class I cesarean sections for term singleton pregnancies in the vertex position with specific indications. The study encompassed 33 cases in the mini-incision group and 66 cases in the conventional incision group.

This study received approval from the Ethics Committee of the Second Nanning People's Hospital. This clinical study adheres to the provisions of the Declaration of Helsinki, the Ethical Review Measures for Research Involving Human Life Sciences and Medical Research, the Administrative Measures for Investigator-Initiated Clinical Research in Medical and Health Institutions (Trial), and the Regulations on the Management of Human Genetic Resources of the People's Republic of China, as well as other relevant laws and regulations.

The Ethics Committee has agreed to waive the requirement for informed consent from the participants, as the study involves minimal risk and does not compromise the rights and welfare of the participants.

The project researchers will collectively bear the responsibility for maintaining the confidentiality of the participants' relevant information and commit to not disclosing any content related to the participants. Any public report of the results of this study will not reveal the personal identities of the participants. We will make every effort, within the bounds of the law, to protect the privacy of the participants' personal medical data and personal information.

Inclusion and exclusion criteria

Inclusion criteria:

1. Use of a Pfannenstiel incision with a length ranging from 10 to 12 cm. This range was chosen based on previous studies indicating that the median incision length for cesarean sections is approximately 15 cm, while the biparietal diameter of a term fetus is generally over 9 cm. The selected incision length of 10–12 cm allows for safe delivery while minimizing potential maternal and fetal injuries.
2. Classification of emergency cesarean sections in accordance with the Chinese expert consensus on cesarean sections and the NICE guidelines [9, 10], excluding Class I cesarean sections (Non-Class I cesarean sections are those that do not pose an immediate life threat to the mother or fetus. These cesarean sections exclude Class I cesarean sections, which are defined as situations requiring immediate delivery to prevent significant morbidity or mortality. Non-Class I cesarean sections typically include Class II, III, and IV cesarean sections.).
3. Gestational age of 37 weeks or more.
4. Singleton pregnancy.
5. Cephalic presentation.
6. Absence of previous uterine surgery or cesarean section history.

Exclusion criteria:

1. Vertical incision.
2. Class I cesarean section (posing an immediate life threat to the mother or fetus).
3. Multiple pregnancies.
4. Fetal congenital abnormalities. Stillbirth prior to admission.
5. Non-cephalic presentation.
6. Placenta previa.
7. Uncontrolled gestational diabetes.
8. Incomplete or missing clinical data.

Research methods and observational metrics

To account for potential confounders, we implemented several strategies. All surgeries were performed by experienced surgeons, and the years of experience were recorded and analyzed as a variable in our study. Additionally, we conducted a comprehensive assessment of patient comorbidities at the time of recruitment, utilizing a standardized scoring system to quantify the severity of these conditions. These comorbidities were included as covariates in our statistical analyses to control for their potential impact on surgical outcomes. Furthermore, we performed sensitivity analyses to assess the influence of varying levels of surgeon experience and patient comorbidities on our results.

Eligible pregnant women were divided into the mini-incision group and the conventional incision group. Both groups underwent spinal anesthesia, preoperative abdominal preparation, and standard disinfection procedures. All participants received first-generation cephalosporin antibiotics 60 min prior to the surgery to prevent infection. The study compared the following parameters: incision-to-delivery interval (I-D), use of forceps assistance, surgery duration, intraoperative blood loss, post-operative antibiotic duration, post-operative hospitalization duration, and adverse neonatal outcomes (including 1-min low Apgar scores, transfer to the NICU, or death within 24 h, intracranial hemorrhage, and birth trauma). Additionally, the study evaluated fetal and maternal parameters: fetal ultrasound measurements (biparietal diameter, head circumference, abdominal circumference) taken within the week prior to delivery; umbilical artery blood gas analysis (including pH, base excess, and lactate levels); pre- and post-operative hemoglobin (Hb) levels and the extent of Hb decline; pre- and post-operative white blood cell count (WBC); pre- and post-operative hematocrit (HCT); and pre- and post-operative neutrophil percentage (NEU%). Preoperative data were collected from the first examination during the current hospitalization, while postoperative data were obtained from the day following surgery.

Statistical analysis

The study data were statistically analyzed using SPSS 29.0 software. Measurement data that followed a normal or approximately normal distribution were expressed as mean ± standard deviation ($\bar{x} \pm s$). The normality of the data was assessed using the Shapiro–Wilk test, and homogeneity of variances was evaluated using Levene's test. Comparisons of these indices between the two groups were performed using the t-test, with a *P*-value of less than 0.05 indicating statistical significance. Categorical data were expressed as percentages (%), and the chi-square (χ^2) test was used for comparisons, ensuring that the expected frequency in each category was at least 5. A *P*-value of less than 0.05 indicated statistical significance.

Results

Differences in demographic characteristics between the two groups

The results showed no statistically significant differences between the two groups regarding maternal age, pre-pregnancy BMI (body mass index), pre-delivery BMI,

Table 1 Comparison of general characteristics between two groups of pregnant women M (P25, P75)

	mini-incision group (33cases)	conventional incision group (66cases)	z	P	95%CI
Age (Year)	29.00(26.00,34.00)	31.00(27.00,34.25)	−0.855	0.392	(−1.00, 3.00)
pre-pregnancy BMI (kg/m2)	22.35(20.00,24.72)	21.31(19.92,23.67)	−0.958	0.338	(−1.92, 0.74)
pre-delivery BMI (kg/m2)	27.55(25.02,29.86)	26.62(20.08,28.24)	−0.694	0.488	(−1.77, 0.98)
gestational weight gain (kg)	11.00(7.00,15.00)	11.50(9.00,15.13)	−0.896	0.370	(−1.00, 3.00)
Gravidity	1.00(1.00,2.50)	1.00(1.00,2.25)	−0.510	0.610	(0.00, 0.00)
Parity	1.00(1.00,1.50)	1.00(1.00,1.00)	−1.316	0.188	(0.00, 0.00)

BMI Body Mass Index

gestational weight gain, gravidity, and parity, ($P>0.05$) (Table 1).

Comparing blood routine parameters and ultrasound indicators

The differences observed between the preoperative and postoperative measurements of white blood cell count (WBC), hemoglobin (Hb), hematocrit (HCT), neutrophil percentage (NEU%), extent of Hb decline, biparietal diameter (BPD), head circumference (HC), and abdominal circumference (AC) were not statistically significant ($P>0.05$) (Table 2).

Comparison of surgical-related parameters

The surgery duration for the mini-incisions group was notably shorter compared to the conventional incision group. However, The rate of forceps-assisted deliveries in the mini-incision group was higher than that in the conventional incision group.These differences were statistically significant, ($P<0.05$). Conversely, there were no statistically significant differences between the two groups regarding the incision-to-delivery interval, intraoperative blood loss, postoperative antibiotic duration, and postoperative hospitalization duration ($P>0.05$) (Table 3).

Comparison of maternal and infant outcomes

In both the mini-incision and conventional incision groups, there were no reported cases of complications such as postpartum hemorrhage, incision infection, incision fat liquefaction, neonatal birth trauma, neonatal intracranial hemorrhage, low 1-min Apgar scores, neonatal transfer to the NICU, or neonatal death within 24 h. This lack of complications is a significant outcome of our study, indicating the safety of both surgical approaches. Furthermore, the differences in gestational

Table 2 Comparison of blood routine parameters and ultrasound indicators ($\bar{x}\pm s$) M (P25, P75)

	mini-incision group (33cases)	conventional incision group (66cases)	t/z	p	95%CI
WBC (10^9/L)					
pre-operative	9.18 ± 2.15	9.22 ± 1.74	−0.094	0.925	(−0.84, 0.76)
post-operative	13.70(11.90,16.35)	12.35(11.00,15.23)	−1.426	1.541	(−2.00, 0.30)
HB (g/L)					
pre-operative	121.97 ± 13.01	121.55 ± 13.06	0.153	0.879	(−5.10, 5.94)
post-operative	110.00 ± 13.42	111.30 ± 12.50	−0.477	0.634	(−6.72, 4,12)
Extent of HB decline	10.00(5.50,17.00)	9.00(5.00,14.00)	−0.851	0.395	(−4.00, 2.00)
HCT					
pre-operative	0.371 ± 0.035	0.371 ± 0.033	−0.036	0.971	(−0.01, 0.01)
post-operative	0.336 ± 0.040	0.342 ± 0.034	−0.816	0.416	(−0.02, 0.01)
NEU%					
pre-operative	0.718 ± 0.066	0.727 ± 0.061	−0.618	0.538	(−0.03, 0.02)
post-operative	0.821 ± 0.042	0.809 ± 0.050)	1.249	0.215	(−0.01, 0.03)
BPD (mm)	92.48 ± 3.47	92.48 ± 3.01	0.000	> 0.99	(−1.34, 1.34)
HC (mm)	332.00(322.00,355.00)	332.00(320.75,338.00)	−0.501	0.616	(-4.00, 6.00)
AC (mm)	336.97 ± 16.46	339.30 ± 18.14	−0.622	0.536	(−9.78, 5.12)

WBC White Blood Cell, *HB* Hemoglobin, *HCT* Hematocrit, *NEU%* Neutrophil Percentage, *BPD* Biparietal Diameter, *HC* Head Circumference, *AC* Abdominal Circumference

Table 3 Comparison of surgical-related parameters ($\bar{x}\pm s$) M (P25, P75) (n%)

	mini-incision group (33cases)	conventional incision group (66cases)	Z/χ^2	P	95%CI
I-D (min)	5.00(4.00,6.50)	5.00(4.00,7.00)	−0.576	0.565	(−1.00, 1.00)
Surgery duration (min)	47.52 ± 10.33	53.41 ± 10.09	−2.178	0.008	(−10.20, −1.59)
Intraoperative blood loss (ml)	300(400,400)	300(300,400)	−1.425	0.154	(0.00, 0.00)
Post-operative antibiotic duration (day)	1.00(1.00,1.00)	1.00(1.00,2.00)	−1.872	0.061	(0.00, 0.00)
Post-operative hospitalization duration (day)	4.00(4.00,4.00)	4.00(4.00,4.00)	−1.077	0.282	(0.00, 0.00)
Forceps assistance	16(48.48%)	11(16.67%)	11.229	< 0.001	(1.84,12.06)

I-D incision-to-delivery interval

Table 4 Comparison of maternal and infant outcomes ($\bar{x}\pm s$) M (P25, P75)

	mini-incision group (33cases)	conventional incision group (66cases)	Z/t	P	95%CI
Gestational weeks (day)	277.00(269.00,281.00)	274.50(271.00,281.00)	−0.621	0.535	(−2.00, 5.00)
Birth weight (g)	3257.88 ± 352.20	3311.972 ± 428.52	−0.627	0.532	(−225.44, 117.26)
Umbilical artery blood gas analysis					
pH values	7.26(7.20,7.30)	7.27(7.23,7.31)	−1.365	0.172	(−0.01, 0.05)
BE (mmol/L)	−3.65(−5.25,−1.95)	−3.10(−3.90,−2.03)	−1.088	0.277	(−0.40, 1.50)
Lac (mmol/L)	2.90(2.25,3.95)	2.80(2.10,3.45)	−1.111	0.267	(−0.60, 1.20)

BE Base Excess, *Lac* Lactat

age at delivery, birth weight, pH values, base excess (BE), and lactate (Lac) levels between the two groups were not statistically significant, ($P > 0.05$) (Table 4).

Discussion

In this study, our primary aim was to investigate the feasibility of performing cesarean sections through mini-incision. We acknowledge that this study is exploratory in nature, and the brief duration constrained our sample size, resulting in the lack of a formal power analysis. This decision was primarily due to our concern that a single-center study with a limited time frame might not adequately reflect broader population dynamics. Therefore, we emphasize the exploratory nature of this research and suggest that future studies should adopt larger, multi-center designs to validate our results and enhance their applicability in diverse clinical contexts. Future studies with larger, multi-center designs would be beneficial to validate our results and enhance their applicability in diverse clinical contexts. Nonetheless, We find these preliminary findings clinically relevant and a foundation for future research. Future studies should consider multi-center collaborations to expand the sample size, thereby corroborating our results and enhancing their general applicability. These multi-center studies will help provide a more comprehensive understanding of the effects across different populations and may reveal individual differences that impact the outcomes of mini-incision cesarean sections, such as patient demographics and preoperative health status. Additionally, the variability in surgical proficiency and experience among different medical centers may significantly influence the outcomes of mini-incision cesarean sections. In centers with more experienced surgical teams, the success rates and patient satisfaction may be higher, while those with relatively less experience may face more challenges, such as increased complication rates and prolonged recovery times. The lack of significant differences in preoperative and post-operative laboratory values, fetal ultrasound parameters, and umbilical artery blood gas analysis between the two groups is reassuring. This suggests that mini-incision cesarean sections do not compromise maternal or neonatal health outcomes. We can further emphasize the clinical significance of mini-incision cesarean sections on maternal and neonatal health outcomes. The shorter surgery duration observed in the mini-incision group is particularly noteworthy, as it indicates greater efficiency and reduced time requirements for surgeons. This could potentially reduce stress and fatigue for both patients and healthcare providers, contributing to better overall surgical outcomes. In resource-limited healthcare settings, implementing mini-incision cesarean sections may face additional challenges, such as insufficient equipment, lack of anesthesia support, and limited postoperative care resources. These factors could impact the safety and effectiveness of the procedures, and thus careful

consideration of these challenges is essential when implementing this technique in diverse contexts. The emphasis on aesthetic outcomes is also significant, as many women are concerned about the appearance of scars following cesarean sections. While aesthetic considerations are central to the study, we note that no direct metrics, such as patient-reported satisfaction, are included in our analysis. To strengthen this aspect of the research, we recommend that future studies incorporate both quantitative and qualitative measures of aesthetic outcomes. This could involve using standardized questionnaires to assess patient satisfaction with scar appearance, as well as conducting interviews or focus groups to gather in-depth feedback on patients' perceptions of their surgical results. Such measures would provide valuable insights into the impact of mini-incision cesarean sections on patients' quality of life and overall satisfaction with their surgical experience.

Additionally, exploring the correlation between aesthetic outcomes and overall patient satisfaction could help clinicians understand the importance of aesthetic considerations in surgical decision-making. By addressing these factors, future research can provide a more comprehensive evaluation of the benefits of mini-incision techniques, ultimately leading to improved patient care and outcomes.

In this study, our primary aim was to investigate the feasibility of performing cesarean sections through mini-incision. We recruited a sample of 99 cases; however, we acknowledge that the brief duration of the study constrained our sample size and that a formal power analysis was not conducted. This decision was primarily due to our concern that a single-center study with a limited time frame might not adequately reflect broader population dynamics. Future studies with larger, multi-center designs would be beneficial to validate our results and enhance their applicability in diverse clinical contexts. Nonetheless, we consider these preliminary findings clinically relevant and a basis for subsequent research. The lack of significant differences in preoperative and postoperative laboratory values, fetal ultrasound parameters, and umbilical artery blood gas analysis between the two groups is reassuring. This suggests that mini-incision cesarean sections do not compromise maternal or neonatal health outcomes. The shorter surgery duration observed in the mini-incision group is particularly noteworthy, as it indicates greater efficiency and reduced time requirements for surgeons. This could potentially reduce stress and fatigue for both patients and healthcare providers, contributing to better overall surgical outcomes. The emphasis on aesthetic outcomes is also significant, as many women are concerned about the appearance of scars following cesarean sections. Mini-incision surgery can address these concerns and enhance patient satisfaction with the surgical experience. However, as mentioned, future studies should involve multicenter collaborations to increase the sample size and validate these findings. Additionally, exploring the impact of individual differences, such as patient demographics and preoperative health status, on the outcomes of mini-incision cesarean sections would be beneficial. This could help identify which patients are most likely to benefit from this approach and ensure its appropriate use in various clinical settings.

It is important to note that surgical proficiency can vary significantly across different centers and practitioners. This variability may influence not only the outcomes of mini-incision cesarean sections but also the overall adoption of this technique. Centers with more experienced surgical teams may achieve better results, while those with less experience may face challenges that could impact patient safety and satisfaction. Therefore, future research should aim to assess how surgical proficiency and experience level affect the outcomes of mini-incision procedures.Nonetheless, we consider these preliminary findings clinically relevant and a basis for subsequent research. Future studies should consider a multicenter collaborative approach to expand the sample size, thereby corroborating our results and enhancing their general applicability.

Additionally, the implementation of standardized training programs for mini-incision techniques could play a crucial role in improving surgical outcomes. Standardization may help in reducing variability in practice and ensuring that all surgical teams adhere to best practices. Future studies could explore the effectiveness of such training initiatives and their impact on the adoption of mini-incision techniques across various clinical settings. Furthermore, we recommend that future research consider implementing standardized training programs to enhance the skills of surgeons in performing mini-incision techniques. This will help reduce variability in practice and ensure that all surgical teams adhere to best practices, thereby improving the safety and effectiveness of surgical outcomes.

Overall, our study provides a strong foundation for further research into the feasibility and benefits of mini-incision cesarean sections. The results suggest that this approach may be a safe and effective alternative to conventional incisions, potentially offering additional benefits such as reduced surgery duration and increased patient satisfaction. Furthermore, the aesthetic advantages of mini-incision techniques can significantly enhance the postoperative experience for patients, addressing their concerns about scarring and body image.

The absence of complications in both groups is a significant finding. This finding not only reinforces the safety of mini-incision cesarean sections but also suggests that this technique may offer a viable alternative for patients seeking less invasive surgical options. Additionally, the consistent outcomes across both groups strengthen the overall validity of our study. This adds weight to the study's conclusion regarding the safety of mini-incision cesarean sections.

Principal findings of this study

Differences in blood routine parameters, ultrasound indicators, and surgical metrics

We found no statistically significant differences between the two groups in preoperative and postoperative white blood cell (WBC) counts, hemoglobin (HB) levels, hematocrit (HCT) values, neutrophil percentage (NEU%), the extent of Hb decline, and ultrasound indicators such as biparietal diameter (BPD), head circumference (HC), and abdominal circumference (AC) (all $P > 0.05$). Previous studies have suggested that transverse incisions may offer advantages over vertical incisions, particularly in cases of placenta previa, obesity, and repeat cesarean deliveries [11–13]. Additionally, transverse incisions are considered aesthetically superior and may carry a lower risk of postoperative pain and hernia formation compared with vertical incisions [14–16]. Consequently, we used the Pfannenstiel incision in all our cases. An international retrospective study has shown that the size of the Pfannenstiel incision in primary cesarean sections can be determined based on the fetal occipitofrontal diameter (OFD) with minimal error [17]. In our study, the absence of significant differences in ultrasound indicators such as BPD, HC, and AC between the two groups currently impedes our ability to predict incision size using these parameters. For future research, we may consider increasing the sample size and collaborating with multiple centers to identify appropriate indicators for determining the optimal size of mini-incisions. Furthermore, the lack of significant differences in routine blood parameters among the groups supports the feasibility of using mini-incisions to a certain degree.

We found no significant differences between the two groups in terms of post-operative antibiotic duration or post-operative hospitalization duration. Preoperative skin disinfection and the use of prophylactic antibiotics are known to reduce surgical site infections in cesarean sections [18]. In our study, we ensured proper skin preparation and disinfection before surgery and administered antibiotics within 60 min prior to surgery to prevent infections. Consistent with previous studies, no surgical site infections were observed in either group. Tension is a key factor influencing scar formation [19–21]. The use of tension-reducing sutures can minimize local wound tension, thus inhibiting scar proliferation to some extent [22, 23]. Effective management of surgical scars requires not only meticulous preoperative planning and post-operative care but also the use of appropriate treatment methods tailored to the type of scar [24]. The tension on the incision is directly proportional to its length [25]. Numerous randomized trials have been conducted on various aspects of cesarean techniques; many have shown that even when statistical differences exist, the absolute differences are often clinically insignificant, emphasizing the importance of time efficiency [26]. Mini-incisions, as compared to conventional incisions, tend to reduce surgery duration. Although fetal extraction can be challenging in some cesarean deliveries, potentially increasing the risk of maternal and neonatal complications [27], mini-incision procedures may face greater challenges in terms of fetal extraction. However, the use of forceps can address this issue. When delivering the fetal head is difficult during cesarean sections, forceps-assisted delivery can be a feasible option [28]. The adverse outcomes and complications of forceps-assisted delivery for newborns include skin markings and lacerations, external eye injuries, intracranial hemorrhage, subgaleal hemorrhage, retinal hemorrhage, fat necrosis, facial nerve injury, skull fractures, and risks of neurodevelopmental abnormalities [29]. However, some studies have indicated that assessments of school-aged children suggest that forceps-assisted delivery does not appear to have a negative impact on neurological development [30, 31]. This may lead to a higher incidence of forceps use in mini-incision procedures, which could introduce additional risks, including the potential for neonatal birth injuries. In this regard, we recommend further studies to evaluate the long-term effects and safety of forceps use in mini-incision cesarean sections to ensure the health and safety of newborns. When the surgeon was unable to deliver the fetus through routine pressure on the uterine fundus, we used cesarean section forceps. While our study did not observe any such injuries, it is crucial to consider these factors when evaluating the overall safety of mini-incision cesarean sections. Additionally, the necessity of informed consent in the clinical decision-making process and the importance of communicating risks to patients should be emphasized to better manage expectations when using forceps. We will inform the pregnant woman before the surgery that forceps-assisted delivery may be needed during the mini-incision cesarean section. Nevertheless, there was no significant difference between the groups in the time taken from skin incision to fetal delivery. These findings strongly support the feasibility of using mini-incisions.

Differences in maternal and infant outcomes

Our study revealed no significant disparities between the two groups in terms of gestational age at delivery and birth weight. While it is currently impractical to predict incision size based solely on gestational age and estimated fetal weight, this indirectly highlights the viability of mini-incisions. Prior research has indicated that a longer duration between uterine incision and fetal delivery is directly associated with decreased fetal blood gas pH values and lower Apgar scores [32]. In our study, the median time from skin incision to fetal delivery was 5 min in both groups, with no significant difference observed. Furthermore, mini-incisions did not significantly affect umbilical artery blood gas analysis values, including pH, base excess (BE), and lactate (Lac), when compared to traditional incisions. Neither group experienced complications such as postpartum hemorrhage, incision infection, fat liquefaction of the incision, neonatal birth trauma, or neonatal intracranial hemorrhage. These findings further support the safety of mini-incisions under specific conditions.

Conclusions

Clinical implications of the study

Based on our preliminary findings, we conclude that, apart from Class I cesarean sections, obstetricians with experience and proficiency in forceps delivery techniques can safely perform mini-incisions. This approach not only addresses aesthetic concerns but also enhances maternal satisfaction and fosters a positive doctor-patient relationship, all without compromising the safety of either the mother or the neonate.

Limitations of the study

However, given the study's relatively short duration, small sample size, and lack of multi-center collaboration, further validation in larger, multicenter studies is necessary to confirm these results and enhance their generalizability.

Prospects

We plan to conduct multi-center, prospective studies in the future to further explore scenarios such as preterm births, twin pregnancies, and non-cephalic presentations.

Acknowledgements

We would like to thank all patients who have made genuine contributions to the article and who endorse the data and conclusions.

Authors' contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

There are no funding sources to be declared.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study received approval from the Ethics Committee of the Second Nanning People's Hospital [Y2024402].

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Obstetrics, The Third Affiliated Hospital of Guangxi Medical University, the Second Nanning People's Hospital, Nanning, No. 13, Dancun Road, Jiangnan District, Nanning City, Guangxi Zhuang Autonomous Region 530031, China.

Received: 10 December 2024 Accepted: 28 January 2025
Published online: 06 February 2025

References

1. Subramaniam A, Jauk V, Saade G, Boggess K, Longo S, Clark EAS, Esplin S, Cleary K, Wapner R, Letson K, Owens MY, Blackwell S, Szychowski JM, Andrews WW, Tita AT. The Association of Cesarean Skin Incision Length and Postoperative Wound Complications. Am J Perinatol. 2022;39(5):539–45. https://doi.org/10.1055/s-0040-1716889. (Epub 2020 Oct 1 PMID: 33003227).
2. Kawakita T, Landy HJ. Surgical site infections after cesarean delivery: epidemiology, prevention and treatment. Matern Health Neonatol Perinatol. 2017;5(3):12. https://doi.org/10.1186/s40748-017-0051-3.PMID:28690864; PMCID:PMC5497372.
3. Ioannidis A, Arvanitidis K, Filidou E, Valatas V, Stavrou G, Michalopoulos A, Kolios G, Kotzampassi K. The Length of Surgical Skin Incision in Postoperative Inflammatory Reaction. JSLS. 2018;22(4):e2018.00045. https://doi.org/10.4293/JSLS.2018.00045. PMID: 30518991; PMCID: PMC6251478.
4. De Vivo A, Mancuso A, Giacobbe A, Priolo AM, De Dominici R, Maggio SL. Wound length and corticosteroid administration as risk factors for surgical-site complications following cesarean section. Acta Obstet Gynecol Scand. 2010;89(3):355–9. https://doi.org/10.3109/00016340903568175. (PMID: 20199351).
5. Huang C, Wu Z, Du Y, The OR, Epidemiology of Keloids. 8. In: Téot L, Mustoe TA, Middelkoop E, Gauglitz GG, editors. Textbook on Scar Management: State of the Art Management and Emerging Technologies. Cham (CH): Springer; 2020. p. 2020.
6. Davis SA, Feldman SR, McMichael AJ. Management of keloids in the United States, 1990–2009: an analysis of the National Ambulatory Medical Care Survey. Dermatol Surg. 2013;39(7):988–94. https://doi.org/10.1111/dsu.12182. (Epub 2013 Mar 6 PMID: 23463963).
7. Sun LM, Wang KH, Lee YC. Keloid incidence in Asian people and its comorbidity with other fibrosis-related diseases: a nationwide population-based study. Arch Dermatol Res. 2014;306(9):803–8. https://doi.org/10.1007/s00403-014-1491-5. (Epub 2014 Aug 1 PMID: 25081927).
8. Libretti A, Bracci B, De Pedrini A, Surico D, Troìa L, Remorgida V. The Dermabond Prineo Skin Closure System: Benefits and Complications. J Gynecol Surg. 2024;0(No.0):123–31.

9. National Center for Obstetric Quality Control, Perinatal Medicine Branch of Chinese Medical Association. Expert Consensus on Cesarean Section (2023). Chin J Obstet Gynecol. 2024;59(1):14–21.
10. 2021 exceptional surveillance of caesarean birth-diamorphine (NICE guideline NG192). London: National Institute for Health and Care Excellence (NICE); 2021. PMID: 34784152.
11. Fan D, Zhang H, Rao J, Lin D, Wu S, Li P, Chen G, Zhou Z, Liu J, Chen T, Chen F, Guo X, Liu Z. Maternal and neonatal outcomes in transverse and vertical skin incision for placenta previa : Skin incision for placenta previa. BMC Pregnancy Childbirth. 2021;21(1):441. https://doi.org/10.1186/s12884-021-03923-1.PMID:34167519;PMCID:PMC8229347.
12. Zoorob D, Zarudskaya O, Van Hook J, Moussa HN. Maternal morbidity associated with skin incision type at cesarean delivery in obese patients: a systematic review. Future Sci OA. 2020;7(3):FSO669. https://doi.org/10.2144/fsoa-2020-0160. PMID: 33552545; PMCID: PMC7850001.
13. Palatnik A, Grobman WA. The association of skin-incision type at cesarean with maternal and neonatal morbidity for women with multiple prior cesarean deliveries. Eur J Obstet Gynecol Reprod Biol. 2015;191:121–4. https://doi.org/10.1016/j.ejogrb.2015.06.009. (Epub 2015 Jun 16 PMID: 26117440).
14. Seiler CM, Deckert A, Diener MK, Knaebel HP, Weigand MA, Victor N, Büchler MW. Midline versus transverse incision in major abdominal surgery: a randomized, double-blind equivalence trial (POVATI: ISRCTN60734227). Ann Surg. 2009;249(6):913–20. https://doi.org/10.1097/SLA.0b013e3181a77c92. (PMID: 19474689).
15. Brown SR, Goodfellow PB. Transverse verses midline incisions for abdominal surgery. Cochrane Database Syst Rev. 2005;2005(4):CD005199. https://doi.org/10.1002/14651858.CD005199.pub2. PMID: 16235395; PMCID: PMC8866010.
16. Bickenbach KA, Karanicolas PJ, Ammori JB, Jayaraman S, Winter JM, Fields RC, Govindarajan A, Nir I, Rocha FG, Brennan MF. Up and down or side to side? A systematic review and meta-analysis examining the impact of incision on outcomes after abdominal surgery. Am J Surg. 2013;206(3):400–9. https://doi.org/10.1016/j.amjsurg.2012.11.008. (Epub 2013 Apr 6 PMID: 23570737).
17. Kaya B, Ozay OE, Ozay AC, Tüten A. Can the Pfannenstiel skin incision length be adjusted according to the fetal head during elective cesarean delivery? Front Surg. 2023;26(10):1227338. https://doi.org/10.3389/fsurg.2023.1227338.PMID:37829600;PMCID:PMC10566367.
18. Hamel MS, Tuuli M. Prevention of Postoperative Surgical Site Infection Following Cesarean Delivery. Obstet Gynecol Clin North Am. 2023;50(2):327–38. https://doi.org/10.1016/j.ogc.2023.02.012. (Epub 2023 Apr 4 PMID: 37149313).
19. Wong VW, Paterno J, Sorkin M, Glotzbach JP, Levi K, Januszyk M, Rustad KC, Longaker MT, Gurtner GC. Mechanical force prolongs acute inflammation via T-cell-dependent pathways during scar formation. FASEB J. 2011;25(12):4498–510. https://doi.org/10.1096/fj.10-178087. (Epub 2011 Sep 12 PMID: 21911593).
20. Gurtner GC, Dauskardt RH, Wong VW, Bhatt KA, Wu K, Vial IN, Padois K, Korman JM, Longaker MT. Improving cutaneous scar formation by controlling the mechanical environment: large animal and phase I studies. Ann Surg. 2011;254(2):217–25. https://doi.org/10.1097/SLA.0b013e318220b159. (PMID: 21606834).
21. Guo F, Carter DE, Leask A. Mechanical tension increases CCN2/CTGF expression and proliferation in gingival fibroblasts via a TGFβ-dependent mechanism. PLoS One. 2011;6(5):e19756. https://doi.org/10.1371/journal.pone.0019756. Epub 2011 May 17. PMID: 21611193; PMCID: PMC3096639.
22. Ogawa R, Akaishi S, Huang C, Dohi T, Aoki M, Omori Y, Koike S, Kobe K, Akimoto M, Hyakusoku H. Clinical applications of basic research that shows reducing skin tension could prevent and treat abnormal scarring: the importance of fascial/subcutaneous tensile reduction sutures and flap surgery for keloid and hypertrophic scar reconstruction. J Nippon Med Sch. 2011;78(2):68–76. https://doi.org/10.1272/jnms.78.68. (PMID: 21551963).
23. Duan T, Liu X, Qi H, et al. Expert Consensus on Suturing Techniques and Material Selection for Cesarean Section (2018). Chin J Pract Gynecol Obstet. 2018;34(04):405–8. https://doi.org/10.19538/j.fk2018040115.
24. Lee Peng G, Kerolus JL. Management of Surgical Scars. Facial Plast Surg Clin North Am. 2019;27(4):513–7. https://doi.org/10.1016/j.fsc.2019.07.013. (PMID: 31587770).
25. Sloan GA. A new upper abdominal incision. Surg Gynecol Obstet. 1927;45:678.
26. Temmerman M. Caesarean section surgical techniques: all equally safe. Lancet. 2016;388(10039):8–9. https://doi.org/10.1016/S0140-6736(16)30355-5. (Epub 2016 May 4 PMID: 27155904).
27. Levy R, Chernomoretz T, Appelman Z, Levin D, Or Y, Hagay ZJ. Head pushing versus reverse breech extraction in cases of impacted fetal head during Cesarean section. Eur J Obstet Gynecol Reprod Biol. 2005;121(1):24–6. https://doi.org/10.1016/j.ejogrb.2004.09.014. (PMID: 15961214).
28. Liu G, Lin Li. Expert Consensus on Clinical Pathways for Rapid Recovery in Obstetrics. Prog Mod Obst Gynecol. 2020;29(08):561–7. https://doi.org/10.13283/j.cnki.xdfckjz.2020.08.001.
29. Chinese Medical Association Obstetrics and Gynecology Branch Obstetrics Group. Guidelines for Vaginal Operative Delivery (2016). Chin J Obstet Gynecol. 2016;51(8):565–7. https://doi.org/10.3760/cma.j.issn.0529-567x.2016.08.002.
30. Bahl R, Patel RR, Swingler R, Ellis M, Murphy DJ. Neurodevelopmental outcome at 5 years after operative delivery in the second stage of labor: a cohort study. Am J Obstet Gynecol. 2007;197(2):147.e1-6. https://doi.org/10.1016/j.ajog.2007.03.034. (PMID: 17689628).
31. Wesley BD, van den Berg BJ, Reece EA. The effect of forceps delivery on cognitive development. Am J Obstet Gynecol. 1993;169(5):1091–5. https://doi.org/10.1016/0002-9378(93)90261-g. (PMID: 8238165).
32. Ammitzbøll ILA, Andersen BR, Lange KHW, Clausen T, Løkkegaard ECL. Risk factors for and consequences of difficult fetal extraction in emergency caesarean section. A retrospective registry-based cohort study. Eur J Obstet Gynecol Reprod Biol. 2023;283:74–80. https://doi.org/10.1016/j.ejogrb.2023.02.012. Epub 2023 Feb 15. PMID: 36801595.

Publisher's Note