

# Optimal Timing and Mode of Delivery After Cesarean with Previous Classical Incision or Myomectomy: A Review of the Data

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Uterine rupture is an obstetrical emergency that can be catastrophic for the mother and fetus. Previous uterine surgery, including previous cesarean delivery or myomectomy, is an established risk factor, although the exact magnitude of the associated risk remains uncertain. We reviewed the literature related to uterine rupture after previous cesarean delivery with classical incision or myomectomy in an attempt to quantify outcomes associated with various management strategies. Although cesarean delivery with a classical incision is relatively uncommon (representing 0.3%-0.4% of deliveries), it presents a significant risk of rupture in subsequent pregnancies (1%-12% on the basis of published reports). Available data suggest that scheduled cesarean at 36-37 weeks optimizes both maternal and fetal outcomes in these cases. Patients with previous myomectomy are more frequently encountered in the obstetrical population. The risk of uterine rupture in subsequent pregnancies in these women is substantially lower than those with a history of previous classical incision (0.5%-0.7% on the basis of published reports). Although less common, given the potentially devastating consequences of uterine rupture, scheduled delivery at 38 weeks is suggested in those women requiring cesarean delivery. Despite the lack of well-controlled studies, preferred management strategies can be gleaned from previously published data to optimize maternal and fetal outcomes in women with these risk factors.

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As late preterm (34-0/7 to 36-6/7 weeks) and late term (37-0/7 to 38-6/7 weeks) are associated with an increasing proportion of neonatal morbidity, the practice of elective delivery before 39 weeks' gestation has been increasingly discouraged.<sup>1-3</sup> It has been estimated that neonatal morbidity doubles for each week of delivery before 38 weeks.<sup>2</sup> Thus, the decision to proceed with scheduled delivery before 39 weeks must be clearly justified by maternal and/or fetal risks. Uterine rupture is a condition associated with potential for both significant maternal and fetal consequences, including still-birth, perinatal hypoxic brain injury, and maternal blood loss

necessitating hysterectomy. Previous uterine surgery, including history of either classical cesarean delivery or myomectomy, represents 2 conditions that present a potential risk for uterine rupture. In such cases, to avoid uterine rupture and its sequelae, scheduled delivery before 39 weeks has been traditionally incorporated into obstetrical practice. Ultimately, when caring for women with previous uterine surgery, the practitioner must weigh the risks associated with prematurity against the risk of catastrophic rupture in formulating a plan for the timing of delivery. In this review, we consider this clinical dilemma to provide some empiric data to better inform those faced with such decision making.

## Previous Classical Cesarean Delivery

Classic cesarean delivery involves a vertical uterine incision involving the upper muscular or contractile portion of the uterus. Although once commonly performed, this type of

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incision is most often performed today in preterm delivery of the fetus in breech presentation. A single-institution 11-year retrospective review of 37,863 deliveries revealed 157 cases (0.4%) of previous classical cesarean delivery.<sup>4</sup> Among the approximate 320,000 births during a 4-year period in the Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal Fetal Medicine Unit Network (NICHD MFMU), 1051 cases of classical incision were present for a similar 0.3% frequency.<sup>5</sup> In this multicenter registry, previous classical scar represented 9% of the 12,289 indicated repeat cesarean deliveries.

Risks of uterine rupture with previous classical incision have ranged from as high as 12%<sup>6,7</sup> to as low as 1% for women undergoing trial of labor.<sup>8</sup> In the MFMU Network study, 2 uterine ruptures were recorded in 105 women (1.9%) with a previous classical, inverted T, or J incision who either presented in advanced labor or refused repeat cesarean section.<sup>5</sup> The American College of Obstetricians and Gynecologists has cited a uterine rupture risk of 4%-9% for women with prior cesarean undergoing trial of labor and thus such practice is contraindicated.<sup>9</sup>

It has been long recognized that women with previous low transverse cesarean may almost universally experience uterine rupture as a complication during active labor; cases of previous classical cesarean may rupture preceding labor with no apparent warning signs.<sup>10</sup> The understanding of this phenomenon as well as the cited risks for rupture with uterine activity has led to a practice of scheduled delivery before 39 weeks for women with previous classical incision; importantly, this has occurred with apparently little data being currently available concerning the risk of uterine rupture before labor in these cases. Further, it is unknown whether the maternal and fetal risks associated with uterine rupture of the classical scar are appreciably different from those associated with previous low transverse rupture in labor. It is conceivable that for cases of rupture preceding labor that greater fetal risks are indeed present. It has been posited that the overall low incidence of uterine rupture after classical cesarean may be less important of an issue than the extent and significance of subsequent uterine rupture given its timing.<sup>10</sup>

The timing of planned repeat cesarean with previous classical incision has been described as an enigma.<sup>11</sup> A questionnaire study of 129 consultant obstetricians in the United Kingdom revealed that only 36% would deliver at 39 weeks, whereas 35% advocated delivery at <38 weeks.<sup>11</sup> This finding is in contrast to cases of multiple previous cesareans, including 3 previous operations in which 71% of those surveyed would deliver at 39 weeks' gestation. In the MFMU Cesarean registry of 1051 cases of previous classical cesarean, the mean gestational age at delivery was 36.1 weeks such that a clear range existed with some scheduled deliveries occurring as late as 39 weeks. In some centers in the United States, a policy of scheduled delivery at 36 weeks has been adopted.<sup>4</sup> Chauhan and colleagues<sup>4</sup> reported their 11-year experience of 157 women with previous classical incision in which amniocentesis with delivery at 36 weeks was planned. Of these cases, only 33% (52/157) underwent amniocentesis, as 77 women (49%) presented in preterm labor before amniocen-

tesis or planned repeat cesarean delivery could be accomplished. The remainder had indications for delivery before 36 weeks. The overall mean gestational age at delivery was 34.8 weeks in this series.

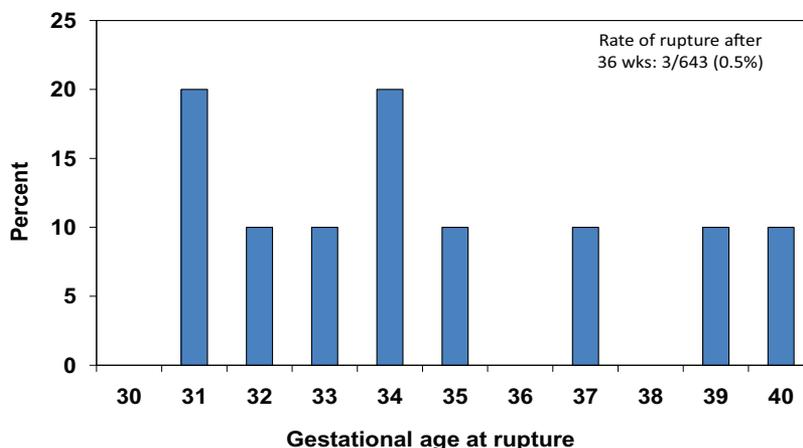
In Chauhan's study, only one case of uterine rupture occurred, in a woman at 29 weeks in association with placental abruption. These authors, however, noted 15 of 157 (9.6%) cases of asymptomatic uterine dehiscence at the time of repeat operation. In this series only 17% of women presented in active labor (dilated 4 cm or more). This observation as well as the protocol for scheduled 36-week delivery does not allow an estimate for the risk of uterine rupture beyond 36 weeks. It is unknown, for example, how many of the 15 dehiscences would have ruptured if pregnancies were permitted to continue and further, at what gestational age these events would have occurred.

Because the MFMU Cesarean Registry included cases of previous classical cesarean delivered beyond 36 weeks, despite selection bias, these data do provide some contemporary information concerning the risk of delaying delivery for these pregnancies. A total of 10/1051 (.095%) cases of uterine rupture in previous classical cesarean were observed during a 4-year period (Fig. 1). Six hundred forty-three women were delivered beyond 36 weeks with 3 cases (0.5%) of documented rupture. Importantly, 7 ruptures occurred before 36 weeks, which would not have been prevented by a policy of scheduled delivery at that particular gestational age.

The practice of scheduled late preterm or late term delivery can clearly prevent cases of uterine rupture, although the quantifiable risk of this event remains elusive. Better information, however, exists concerning neonatal risks associated with delivery during the period of 36-0/7 to 38-6/7 weeks' gestation. As such, it is nonetheless reasonable to ask whether there is a benefit to delivery beyond 36 weeks' gestation.

In an attempt to answer this question, Stotland and colleagues<sup>12</sup> performed a decision tree analysis comparing 4 different strategies for treating women with a previous classic cesarean delivery and assessed various medical outcomes and quality-adjusted life years. These authors specifically compared outcomes for a hypothetical cohort of 10,000 women undergoing either: (1) delivery at 39 weeks' gestation; (2) delivery at 36 weeks of gestation without amniocentesis; (3) amniocentesis at 36 weeks of gestation with delivery if the fetus was mature and antenatal steroid administration if immature; and (4) weekly amniocentesis starting at 36 weeks of gestation with delivery when mature. Because the authors could not find a value in the literature for the risk of uterine rupture before labor with previous classic hysterotomy, they calculated a 3.7% risk for 36-39 weeks on the basis of an overall 12% risk proportioned for cases in labor and also assumed a uniform weekly rupture rate between 36 and 39 weeks.

In their analysis, the strategy of 36-week delivery without amniocentesis provided the greatest maternal quality adjusted years. Strategy 1, elective cesarean delivery at 39 weeks was associated with the greatest number of fetal deaths and cases of cerebral palsy and conversely the lowest number of respiratory distress syndrome (RDS) cases (Table 1). The au-



**Figure 1** Uterine ruptures by gestational age in women with prior classical cesarean delivery. Data from the NICHD MFMU Cesarean Registry (1999-2002).

thors calculated that in comparing delivery at 36 versus 39 weeks, 27 cesarean deliveries would need to be performed at 36 weeks with 1 associated case of RDS to prevent 1 case of uterine rupture. Finally, a sensitivity analysis was performed to assess the sensitivity of their findings to the choice of outcome probabilities used for their model. Whether the authors considered quality-adjusted life expectancy or the occurrence of major complications, delivery at 36 weeks remained the optimal strategy. In addition, threshold analysis indicated that the incidence of uterine rupture would need to decrease to less than 0.36% between 36 and 39 weeks for any strategy to surpass delivery at 36-weeks gestation.

Although the estimate of uterine rupture risk for women with previous classic cesarean beyond 36 weeks is imprecise, we concur that delivery at 36-37 weeks is a reasonable clinical strategy in these cases. Assuming a 1% risk of rupture each week beyond 36 weeks, and the calculated rate of one prevented case of RDS for 1 uterine rupture, the risk/benefit ratio favors early delivery as uterine rupture can have catastrophic consequences for the woman and her family. When one uses data concerning the rate of hypoxic ischemic encephalopathy (HIE) (approximately 5%) after uterine rupture from the MFMU Cesarean registry and the frequency of RDS cited by Stotland et al, if delivery is undertaken at 36 weeks' gestation, the trade-off is approximately 22 cases of RDS encountered to prevent 1 case of HIE associated with uterine rupture (Table 2). To summarize, our knowledge

concerning delivery of women with prior classical incision indicates the following:

- current management in women with previous classical cesarean is to perform a repeat operation at 36-37 weeks' gestation;
- this approach has been undertaken despite little to no information concerning the risk of uterine rupture between 36 and 39 weeks' gestation in this population; and
- Risk/benefit analysis using currently available data suggest that delivery at 36-37 weeks' gestation is a reasonable option

### Previous Myomectomy

Uterine fibroids represent the most common benign tumors of the female reproductive tract, occurring in approximately 25% of women. Symptomatic fibroids may be associated with menorrhagia, pelvic discomfort, or infertility. For these women who seek to preserve fertility, uterine myomectomy is often undertaken. Although open myomectomy is still performed today, most cases of subserosal and intramural fibroids are treated with a laparoscopic approach. Submucosal fibroids are generally treated hysteroscopically. Before the explosion in minimally invasive surgery, obstetricians recognized the potential for uterine rupture in women with previ-

**Table 1** Perinatal Outcomes Among a Hypothetical Cohort of 10,000 Women with a Previous Classical Cesarean Delivery

Strategy	Description	RDS	CP	Fetal/Infant Death	Hysterectomy	Maternal Death
1	39-week delivery	32	19	115	16	4
2	36-week delivery	330	0*	0*	0*	0*
3	36-week amnio + corticosteroids	229	<1	2	<1	<1
4	Serial amnio	53	1	8	1	<1

Adapted from Stotland et al.<sup>12</sup>

Amnio, amniocentesis; CP, cerebral palsy; RDS, respiratory distress syndrome.

\*The difference is above the background rate of these complications.

**Table 2** Management of Pregnancy After Previous Classical Cesarean Delivery: Repeat Cesarean at 36 Weeks

	Number Needed to Treat
Number of cesareans	666
Cases of RDS	22
Uterine rupture prevented	20
Cases HIE prevented	1

CP, cerebral palsy; HIE, hypoxic ischemic encephalopathy; RDS, respiratory distress syndrome.

ous myomectomy. Little information existed to guide physicians as to which cases might be permitted to labor versus those requiring cesarean delivery to prevent uterine rupture. Obstetricians used clinical judgment in assessing the risk for rupture, often regarding those cases in which the uterine cavity was violated during myomectomy to be at greatest risk. In these cases, scheduled cesarean between 36 and 39 weeks became common management. In the era of laparoscopic myomectomy, it appears that little has changed with regard to the obstetrical approach to these women in both selecting mode and timing of delivery.

A history of previous myomectomy is not uncommon among reproductive age women. Of 24,739 primary cesareans performed during a 2-year period in the MFMU Cesarean Registry, 222 (0.9%) had previous myomectomy as the recorded indication. The mean gestational age at delivery was 37.1 weeks, with the greatest proportion (nearly 35%) undergoing delivery between 38 and 39 weeks (Fig. 2). Thus, it appears that obstetricians consider previous myomectomy as a group to be lower risk for rupture than women with prior classical incision.

In a review of recent literature, Nahum and Pham<sup>13</sup> found an overall uterine rupture rate of 0.7% among women with previous myomectomy. In this report; the rate was 1.7% for 179 women with previous laparotomy for fibroid removal compared with 0.49% for 822 women undergoing laparoscopic removal. Kelly and colleagues<sup>14</sup> conducted a retrospective review of post open myomectomy pregnancies

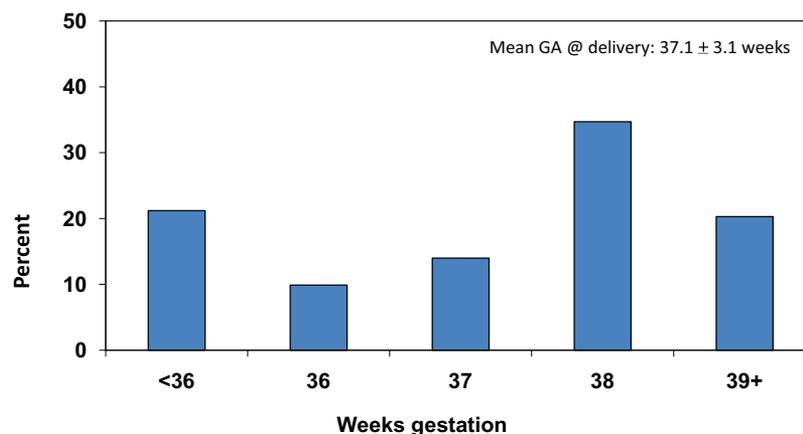
**Table 3** Uterine Ruptures After Previous Laparoscopic Myomectomy

Author	n	Vaginal Delivery, %	Ruptures
Dubuisson <sup>15</sup>	100	—	1
Landi <sup>16</sup>	57	54	0
Kumakiri <sup>17</sup>	32	59	0
Soriano <sup>18</sup>	34	77	0
Seinera <sup>19</sup>	56	20	0
Seracchioli <sup>20</sup>	110	25	0

(1989-2004) that included 92 cases. Fifty-four of these women were allowed to labor with 45 achieving vaginal delivery and no reported cases of uterine rupture. Remarkably, the single case of uterine rupture in this study involved a woman with previous laparoscopic myomectomy.

Laparoscopic myomectomy offers a more rapid recovery than the open method with associated shorter hospitalization. It also has been promoted as a procedure associated with lower risks for pelvic adhesions. Among the 222 cases of previous myomectomy (1999-2000) undergoing primary cesarean in the MFMU Network, none was performed because of uterine rupture. The risk for uterine rupture of 0.49% cited by Nahum and Pham is comparable with the 0.7% risk of rupture in women with previous low transverse cesarean undergoing trial of labor.<sup>5</sup> The authors of many case series published after 2000 report no cases of uterine rupture with vaginal delivery rates varying between 20% and 77% (Table 3).<sup>15-20</sup> However, a recent review includes 19 case reports of uterine rupture after laparoscopic myomectomy.<sup>21</sup> Two important findings are notable on review of these cases. First, most involve rupture before labor and thus intrapartum rupture in selected cases appears to be rare. Second, of the 19 cases reported, 15 ruptures occurred before 36 weeks' gestation (median, 29 weeks).

It has been postulated that rupture after laparoscopic myomectomy may be related to the technique of closure as well as the use of electrocautery during the procedure. Parker and colleagues<sup>21</sup> recently reviewed the 19 reported cases of uter-

**Figure 2** Previous myomectomy: gestational age at cesarean delivery. Data from the NICHD MFMU Cesarean Registry (1999-2002).

**Table 4** Management of Pregnancy After Previous Myomectomy: Risks by Timing of Delivery

	38 Weeks, %	39 Weeks, %
Rupture	—	0.5-1.0
Hysterectomy	—	0.05-0.1
HIE/NND	—	0.025-0.05
Stillbirth	—	0.2
NICU admit	8.1	5.9
TTN	3.9	2.7
RDS	1.9	0.9

HIE, hypoxic ischemic encephalopathy; NICU, neonatal intensive care unit; NND, neonatal death; RDS, respiratory distress syndrome; TTN, transient tachypnea of the newborn.

ine rupture after laparoscopic myomectomy to determine whether common causal factors could be identified. These authors noted that only 3 cases involved multilayer closure technique of defects and that electrocautery was commonly used for hemostasis. Recognizing the limitations of their review, the authors did offer the suggestion that surgeons limit the use of electrocautery and use multilayer closure in all cases involving other than superficial defects. Although cases involving bulk single layer closure or extensive cautery may be at risk for uterine rupture, it is unknown whether ultrasound measurement of myometrial thickness can effectively identify cases at greatest risk and incorporate such findings into obstetrical management, including the timing of delivery.

Given the low risk of uterine rupture after laparoscopic myomectomy, should the recommended timing of delivery for those selected to undergo cesarean be any different from for women with prior low transverse cesarean (39 weeks' gestation)? Table 4 compares the reported risks derived primarily from the MFMU Network Cesarean Registry for various complications associated with delivery of such women at either 38 or 39 weeks.<sup>3,5</sup> The rates of uterine rupture are given as a range of 0.5%-1.0%, although we recognize that this is an imprecise estimate. The use of a strategy of delivery at 38 weeks compared with 39 weeks results in between 7 and 14 cases of transient tachypnea of the newborn or RDS to prevent 1 case of either hysterectomy, HIE, neonatal death or antepartum stillbirth.

In summary for the 55% of women who achieve pregnancy after laparoscopic myomectomy, the primary issue is the potential for uterine rupture. Based upon review of the existing literature and opinion, these conclusions follow:

1. There is a lack of high-quality data from well-designed studies to accurately estimate the risk of uterine rupture in pregnancy following laparoscopic myomectomy.
2. There are insufficient data regarding risk factors (eg, myoma size, operative technique) to identify cases at greatest risk for rupture.
3. Given currently available evidence, the risk appears to be low and comparable with the risk after low transverse cesarean delivery with trial of labor among women without previous myomectomy (<1%).

4. Despite the low risk for rupture, consequences can be devastating for the mother and fetus.

Therefore, in cases selected for cesarean delivery, scheduled operation at 38 weeks should be considered.

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