

# Optimal Timing of Cesarean Delivery in Pregnant Women with Previous Cesarean Delivery

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## ABSTRACT

**Objectives:** In this study, we aimed to determine the optimal fetal and maternal timing of Cesarean delivery in pregnant women with previous cesarean delivery.

**Material/Method:** In the one-year study period, a total of 150 pregnant women with a singleton pregnancy and gestational age between 37-40 weeks were included in the study. The data of pregnant women and newborns were prospectively examined. Pregnant women were divided into three groups according to their gestational age: those within 37 weeks, those within 38 weeks, and those within 39 weeks. The initiation of active labor and the previous cesarean section in pregnant women with 37 and 38 weeks of gestation included in the study are indications for cesarean section. Those with a gestational age of 39 weeks are those who were given the day of planned cesarean section. In this group, the incision is a previous cesarean section. Gravida, parity, age information, additional diseases, and number of cesarean deliveries of pregnant women were recorded. Fetal and birth complications experienced during birth were recorded. One-minute and 5-minute Apgar scores, birth weights, gender, and need for intensive care of newborns were recorded.

**Results:** Apgar scores at 1 minute and 5 minutes were significantly lower at 37 weeks compared to other weeks ( $p < 0.001$ ). Need for intensive care ranged from 45.5-68.2% between 37+0 and 37+6 weeks, 22.7-40.9% between 38+0 and 38+6 weeks, and 0-4.5% after 39 weeks. In the evaluation of the groups, it was observed that the median age value of the pregnant women was significantly higher in the group with 38 weeks of gestation than in the groups with 37 and 39 weeks of gestation ( $p < 0.001$ ).

**Conclusion:** It was determined that the most appropriate gestational week for delivery time in pregnant women with cesarean history was 39 weeks and later.

**Keywords:** Pregnancy; cesarean section; cesarean delivery; term birth

## Daha Önce Sezaryenle Doğum Yapmış Gebelerde Sezaryen Doğumun Optimal Zamanlaması

### ÖZET

**Amaç:** Bu çalışmada, daha önce sezaryen ile doğum yapmış gebelerde sezaryen doğumun optimal fetal ve maternal zamanlamasını belirlemeyi amaçladık.

**Materyal/Yöntem:** Bir yıllık çalışma süresinde tekil gebeliği olan ve gebelik yaşı 37-40 hafta arasında olan toplam 150 gebe çalışmaya dahil edildi. Gebe ve yenidoğan verileri prospektif olarak incelendi. Gebeler gebelik yaşlarına göre 37 hafta, 38 hafta ve 39 hafta olmak üzere üç gruba ayrıldı. Çalışmaya dahil edilen 37 ve 38 haftalık gebelerde aktif doğum eyleminin başlaması ve daha önce sezaryen olması sezaryen endikasyonudur. 39 hafta gebelik yaşı olanlar ise planlı sezaryen ameliyat günü verilenlerdir. Bu grup içinde enkiyasyon daha önce gecirilmiş sezaryen ameliyatıdır. Gebelerin gravida, parite, yaş bilgileri, ek hastalıkları ve sezaryen doğum sayıları kaydedildi. Doğum sırasında yaşanan fetal ve doğum komplikasyonları kaydedildi. Yenidoğanların 1. dakika ve 5. dakika apgar skorları, doğum ağırlıkları, cinsiyetleri ve yoğun bakım ihtiyaçları kaydedildi.

**Bulgular:** 1. dakika ve 5. dakika apgar skorları 37. haftada diğer haftalara göre anlamlı derecede düşüktü ( $p < 0.001$ ). Yoğun bakım ihtiyacı 37+0 ile 37+6 haftalar arasında % 45,5-68,2, 38+0 ile 38+6 haftalar arasında %22,7-40,9 ve 39 hafta sonra %0-4,5 arasında değişmektedir. Grupların değerlendirilmesinde, gebelerin medyan yaş değerinin gebelik haftası 38 haftalık olan grupta, gebelik haftası 37 ve 39 haftalık gruplara göre anlamlı olarak daha yüksek olduğunu görüldü ( $p < 0.001$ ).

**Sonuç:** Sezaryen öyküsü olan gebelerde doğum süresi için en uygun gebelik haftasının 39 hafta ve sonrası olduğu belirlendi.

**Anahtar Kelimeler:** Gebelik; sezaryen; sezaryen doğum; vadedi doğum

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For singleton fetuses in humans, the fetal developmental period is generally calculated according to the mother's last menstrual period. This period is the time from the mother's last menstrual period until the end of the 37 weeks of pregnancy. A "term baby" refers to a baby that has completed 37 weeks of pregnancy (1). In recent times, considering the problems experienced by term babies after birth, the definition of term baby has become controversial. Therefore, babies born between the first day of the 37<sup>th</sup> week and last day of the 38<sup>th</sup> week were called "early term" (1). Today, it has been asserted that the time until fetal maturation to be considered completed, should be 38 weeks and 2 days from ovulation (2). In general, babies born before the 37<sup>th</sup> week are referred to as "premature babies"(3). About one out of five babies born without complications are early term babies (2). Morbidity and mortality rates vary after birth depending on the gestational age in early term babies (4). The reason for the majority of cesarean deliveries in our country and our hospital is the presence of a previous cesarean operation. In such cases, our patients are scheduled for elective cesarean delivery. In these deliveries, considering the morbidity and mortality of the newborn, it is important to plan the time of delivery. There is no consensus on the subject. In our study, we aimed to determine the optimal delivery time for planned cesarean deliveries in pregnant women.

## MATERIAL AND METHOD

In the one-year study period, a total of 150 pregnant women with a singleton pregnancy and gestational age varying between 37-40 weeks were included in the study.

Pregnant women at 37, 38 and 39 weeks were selected by stratified sampling method according to their gestational weeks.

While the groups were randomized, pregnant women with a gestational age of 40 weeks and above were not included in the grouping due to the low number of pregnant women. Those with a gestational age below 37 weeks were not included due to problems that may be related to prematurity. All pregnant women were screened for congenital anomalies between 20 and 22 weeks with detailed ultrasonography. Those with congenital anomaly were not included in the study. All pregnant women were treated by the same anesthesia team using the same methods. Pregnant women who had a previous cesarean section and planned a cesarean section for the next delivery were included in our study. The initiation of active labor and the previous cesarean section in pregnant

women with 37 and 38 weeks of gestation included in the study are indications for cesarean section. Those with a gestational age of 39 weeks are those who were given the day of planned cesarean section. In this group, the incision is a previous cesarean section. Sample selection was completed when 50 pregnant women were reached for each of the three trimesters groups who met the inclusion criteria among the pregnant women who applied to our clinic between 1/1/2020 and 1/1/2021. Data of the pregnant women and newborns were prospectively examined. Pregnant women were divided into three groups according to their gestational age: those within 37 weeks, those within 38 weeks, and those within 39 weeks. Pregnant women with fetal anomaly, gestational age under 37 weeks, and women who required emergency cesarean operation were excluded from the study. Gravidity, parity, age information, additional diseases, and number of cesarean deliveries of pregnant women were recorded. Fetal and birth complications experienced during birth were recorded. One-minute (APGAR1) and 5-minute (APGAR5) Apgar scores, birth weights, gender, and need for intensive care of newborns were recorded. In addition, the indications for neonatal intensive care unit (NICU) admission in infants admitted to neonatal intensive care were also recorded. Date of last menstrual period was taken into consideration when calculating gestational age. For pregnant women who did not know the date of their last menstrual period, the date was determined according to ultrasound findings of the first fifteen weeks of pregnancy. For pregnant women who did not know the date of their last menstrual period and who did not have ultrasounds of their first trimester, calculation was based on biparietal diameter (BPD) in ultrasound taken at admission. Naegele formula was used for calculations when determining gestational week according to last menstrual period. Cesarean indication was defined as *previous cesarean section* in those who previously underwent cesarean section, and as *repeat cesarean section* in those who underwent more than two previous cesarean sections. This study was approved as a prospective study by the Human Research Ethics Committee of Zonguldak Bülent Ecevit University. Protocol number: 2019-77-08/05. All participants were informed about the scope of the study and written consent was obtained from all participants. The study was conducted in accordance to the principles of the Declaration of Helsinki.

### Statistical Analysis

Analysis of the data was conducted using the SPSS 22.0 (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp) package program. Normality distribution

of the data was evaluated using the Shapiro-Wilk test and graphically assessed. It was determined that the data was not normally distributed. Numerical data was expressed as median (minimum-maximum) and categorical data was expressed as number and percentage. In the comparison of the three groups, the Kruskal-Wallis test was tested using Monte Carlo simulation results. Independent two groups comparisons of the statistically significant parameters were applied Dun's test. Pearson chi-square test was tested using Monte Carlo simulation results to compare categorical data. ROC analysis was applied to determine the cutoff for the most ideal gestational week for delivery. Logistic regression analysis was used to assess the value of gestational week in predicting the need for NICU. The level of  $p < 0.05$  was considered statistically significant.

## RESULTS

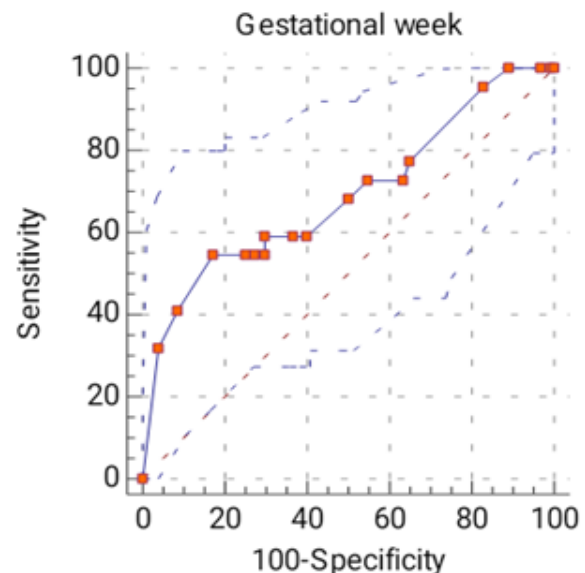
A total of 150 patients were included in the study. The 37-, 38-, and 39-week groups each consisted of 50 patients. Median patient age was 29 (24-39), gravida 2 (2-4), parity 1 (1-3), newborn weight 3207.5 (2700-4300) grams, gestational week 38.3 (36.6-39.4), 1-min Apgar 8 (5-10), and 5-min Apgar 9 (6-10). In terms of comorbidities, in the 37-week group, 6 (12%) patients had anemia, 1 (2%) diabetes mellitus (DM), and 3 (6%) hypertension (HT); in the 38-week group 3 (6%) patients had anemia, 1 (2%) DM, and 1 (2%) asthma; in the 39-week group, 2 (4%) patients had DM. According to complications during labor, only one patient in the 39-week group experienced bowel injury. In terms of postpartum complications, only one patient in the 38-week group developed postpartum hemorrhage. In one patient in the 38-week group, the previous cesarean section had been recorded as vertical incision. One patient in the 39-week group had a history of myomectomy.

In the 37-week group, Respiratory Distress Syndrome (RDS) was observed in 2 (4%) babies and transient tachypnea of the newborn (TTN) in 9 (18%) babies; in the 38-week group, RDS was observed in 1 (2%) baby and TTN in 4 (8%) babies; and in the 39-week group, TTN was observed in 5 (10%) babies. No anomalies were observed in any of the babies. Mortality was not observed in any of the mothers and babies in the three groups.

In the 37-week group, 4 (8%) babies stayed in the newborn unit for 3 days, 7 (14%) for 4 days, and 1 (2%) baby stayed for 5 days; in the 38-week group, 1 (2%) babies stayed for 2 days and 4 (8%) babies stayed for 3 days; and in the 39-week group, 5 (10%) babies stayed for 3 days.

Analysis of the groups revealed that median age was significantly higher in the 38-week group compared to the 37- and 39-week group ( $p < 0.001$ ). The 1-min and 5-min Apgar scores were significantly lower in the 37-week group compared to the other groups ( $p < 0.001$ ). There was a significant difference between all of the groups according to birth weeks and newborn weight ( $p < 0.001$ ). There was no significant difference between the groups according to the rest of the parameters ( $p > 0.05$ ). The rate of babies born at 39 weeks among those in need of NICU is 22.7%. The sensitivity rate for detecting the cut-off point for NICU need at week 39 is 4.5%. The distribution of the demographic data of the groups is presented in Table 1.

Our optimal cut-off value for the gestational week according to the need for intensive care was 37.3%, our sensitivity rate was 54.5%, our specificity rate was 82.8%, our ppv rate was 35.3%, and our npv rate was 91.4%, which was statistically significant (AUC: 0.690 (SE:0.069); CI=0.609-0.763;  $p = 0.006$ ) (Table 2, Graph 1).



**Graph 1.** Sensitivity and specificity comparison of gestational age

According to logistic regression analysis of the 37-week, 38-week, and 39-week groups, it was observed that gestational week was a significant predictor of the development of NICU risk ( $p < 0.001$ ). The risk of NICU need decreased by 68.4% at 38 weeks, and decreased by 88.9% at 39 weeks compared to 37 weeks ( $p < 0.001$ ; OR=0.316 [95% CI: 0.165-0.604] and  $p < 0.001$ ; OR=0.111 [95% CI: 0.044-0.280] respectively) (Table 3).

Table 1. Distribution of demographic data of the groups							
	37 Weeks	38 Weeks	39 Weeks	p	Pairwise comparisons of gestational weeks		
	(n=50)	(n=50)	(n=50)		(37-38)	(37-39)	(38-39)
	median (min-max)	median (min-max)	median (min-max)				
Age	28 (24-36)	30 (24-39)	28 (24-36)	<0.001 <sup>k</sup>	0.067	0.423	0.001
Gravida	2 (2-3)	2 (2-4)	2 (2-3)	0.910 <sup>k</sup>	ns.	ns.	ns.
Parity	1 (1-2)	1 (1-3)	1 (1-2)	0.910 <sup>k</sup>	ns.	ns.	ns.
Newborn weight	3089.5 (2700-3780)	3199 (2740-3865)	3468 (2980-4300)	<0.001 <sup>k</sup>	0.028	<0.001	<0.001
Gestational week	37.3 (37.0-37.7)	38.4 (38.0-38.9)	39.0 (39.0-39.6)	<0.001 <sup>k</sup>	<0.001	<0.001	<0.001
APGAR							
1	7 (5-9)	8 (6-10)	8 (6-9)	<0.001 <sup>k</sup>	<0.001	0.001	0.470
5	9 (6-10)	9 (7-10)	9 (7-10)	<0.001 <sup>k</sup>	<0.001	0.007	0.546
	n (%)	n (%)	n (%)				
Smoking							
Absent	39 (78)	40 (80)	45 (90)	0.246 <sup>c</sup>	ns.	ns.	ns.
Present	11 (22)	10 (20)	5 (10)		ns.	ns.	ns.
Indication							
Previous C/S	33 (66)	33 (66)	34 (68)	0.999 <sup>c</sup>	ns.	ns.	ns.
Repeat C/S	17 (34)	17 (34)	16 (32)		ns.	ns.	ns.
Need for NICU							
Absent	38 (76)	45 (90)	45 (90)	0.930 <sup>c</sup>	ns.	ns.	ns.
Present	12 (24)	5 (10)	5 (10)		ns.	ns.	ns.
Gender							
Female	24 (48)	24 (48)	23 (46)	0.999 <sup>c</sup>	ns.	ns.	ns.
Male	26 (52)	26 (52)	27 (54)		ns.	ns.	ns.

<sup>k</sup> Kruskal Wallis H Test (Monte Carlo); Post Hoc Test: Dunn's Test, <sup>c</sup> Pearson Chi Square Test (Monte Carlo) NICU: Neonatal Intensive Care Unit.

Table 2. ROC Analysis for determining the optimal delivery time				
	Neonatal Intensive Care Unit		AUC (SE)	p
	Absent	Present		
Gestational week				
>37.3 (37w+2d)	106 (91.4) <sup>NPV</sup> (82.8) <sup>SP</sup>	10 (8.6) (45.5)	0.690 (0.069)	0.006
≤37.3 (37w+2d)	22 (64.7) (17.2)	12 (35.3) <sup>PPV</sup> (54.5) <sup>SS</sup>		

Roc (Receiver Operating Curve) Analysis (Honley&Mc Nell - Youden index J), AUC: Area under the ROC curve, SE: Standard Error, <sup>SS</sup> Sensitivity, <sup>SP</sup> Specificity, <sup>PPV</sup> Positive predictive value, <sup>NPV</sup> Negative predictive value

Table 3. Logistic regression analysis of gestational week in predicting NICU need					
	B (SE)	p	Odds ratio	95% C.I. for Odds ratio	
				Lower	Upper
37 vs 38 weeks	-2.197 (0.471)	<0.001	0.111	0.044	0.280
37 vs 39 weeks	-1.153 (0.331)	<0.001	0.316	0.165	0.604

Logistic Regression (Method = Enter), C.I.: Confidence interval B: regression coefficients SE: Standard error, Dependent variable: NICU need.

## DISCUSSION

According to our clinical experiences, planned cesarean deliveries in women who have previously underwent cesarean section are generally performed in the 39<sup>th</sup> gestational week. However, there is no definite consensus regarding the timing of planned cesarean sections in pregnant women with a history of previous cesarean section. In general, the reason for planning delivery at 39 weeks is to reduce newborn morbidity and mortality. According to 2013 data, the mortality rates of newborns born in weeks 37 and 38 were significantly higher compared to newborns born in weeks 39 and 40 (5).

In our study, APGAR1 and APGAR5 scores of the newborns were significantly lower in the 37-week group compared to the other two groups. In addition, it was observed that 39 weeks and later was the most optimal time in order to reduce the need for NICU.

One study on pregnant women who gave birth between 32 and 39 gestational weeks reported that advancing delivery by one week reduced neonatal morbidity by 23% (6). In our study, we observed that the need for neonatal intensive care decreased from 37 weeks to 39 weeks. However, a percentage value was not obtained.

One large-scale Swedish study observed that mortality rates of young adults were significantly higher when they were born in weeks 37 and 38 compared to those born in gestational weeks 39 and 40. The most significant causes of mortality in these young adults were heart diseases and diabetes. Although they could not state that early term birth directly impacted heart disease and diabetes in adulthood, they emphasized that it may have a negative effect (7).

One study conducted in the United Kingdom reported that school performance of children born between gestational weeks 37-39 was significantly lower than those born between weeks 39-41. They emphasized that the effect of delivery between 37-39 weeks of gestation on children's school performance is minimal, but that the effect is significant and real (8).

One Australian study observed that early term babies exhibited more behavioral disorders in adulthood compared to babies born at 39 weeks of gestation and later. They indicated that early term birth may be associated with mental problems (9).

The aforementioned three studies investigated early term babies in their adulthood period. We did not evaluate adulthood of the babies born in our study, which was a limitation.

Another study more similar to the focus of our study emphasized that waiting for the 39<sup>th</sup> week of gestation was not optimal for reducing neonatal morbidity and mortality in pregnant women with repeat cesarean sections. They concluded that waiting for the 39<sup>th</sup> week for optimal cesarean timing would increase maternal and fetal mortality and morbidity by inducing potential emergency delivery with the start of labor. The same study indicated that the optimal delivery time for women with repeat cesarean deliveries should be within 37 weeks of gestation (10). The results of our study do not support this finding. In our study, fetal morbidity decreased as the gestational age approached 39 weeks. There was no significant difference in terms of maternal morbidity and mortality.

Spong et al. emphasized the importance of previous uterine operations and uterine incisions performed in previous cesarean sections in optimally planned cesarean deliveries. They drew attention to the finding that those who underwent cesarean section with vertical uterine incision had higher risk of uterine rupture and that the optimal cesarean delivery time should be 37 weeks in those who previously underwent cesarean section in such a manner. In addition, they emphasized that optimal cesarean delivery time should be between 37-38 weeks in women who previously underwent non-cesarean uterine operations (11). Among the patients of our study, only one of the pregnant women had previously undergone a myomectomy operation. Her cesarean section was performed at 39 weeks of gestation without complications. In the same manner, only one of our patients had previously undergone cesarean operation with classical incision. That patient's cesarean section was performed at 39 weeks of gestation and no fetal or maternal complications developed.

In diabetic women, complications associated with maternal diabetes may develop during pregnancy and birth. Delivery time in diabetic pregnancies is controversial. In diabetic women, pharmacologic management of diabetes during pregnancy is important. In these cases, delivery time may vary depending on whether or not the pregnant woman's diabetes is kept under control. Catalano et al. indicated that when planning optimal cesarean delivery time, macrosomia and sudden infant death syndrome associated with diabetes may be encountered due to advanced gestational week, and they emphasized that this condition may complicate pregnancy.

They recommended that cesarean delivery should be planned close to 39 weeks in pregnant women with diabetes kept under control with pharmacologic agents (12). In our study, we did not observe a significant difference between the three groups according to labor complications in diabetic patients.

In pregnant women with history of intrauterine fetal death in the third trimester, the presence of negative obstetric history causes the clinician concern when planning cesarean delivery time. A study on this topic demonstrated that planning delivery before the 39<sup>th</sup> week of gestation without a medical necessity did not prevent a potential recurrent intrauterine fetal death (13).

It has been indicated that in the presence of fetal anomaly, moving the delivery time to an earlier date did not provide any benefit. It was emphasized that delivery could be performed in the early term if there is risk of fetal or maternal complications (14).

Intrauterine growth retardation (IUGR) is a condition characterized by impaired placentation and sudden fetal death and delivery timing is important. In case of IUGR, if Doppler parameters are normal, with close follow-up, optimal delivery time is recommended between 38-39 weeks of gestation (15).

According to the American College of Obstetricians and Gynecologists (ACOG), various parameters are factors when planning delivery time, and the situation is rather complex. They recommended that risks, application sites, and maternal and fetal benefits should be considered when planning delivery. Based on this information, they suggested that delivery should not be before 39 weeks of gestation. However, in their research, ACOG mentioned that when referring to delivery before 39 weeks, this was in regard to general labor timing and not planning of optimal cesarean timing (16).

### Study Limitations

Since the research was conducted in a single center, the long-term extension of the study to reach a sufficient number of participants can be counted among the limitations of this study.

## CONCLUSION

In pregnant women with a history of previous cesarean section, it is recommended that optimal time of cesarean

delivery is 39 weeks of gestation in order to reduce the need for postnatal intensive care.

## DECLARATIONS

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### Conflict of Interest

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

### Ethics Committee Approval

The study was approved by the Zonguldak Bülent Ecevit University Human Research Ethics Committee (08.05.2019, 2019-77-08/05).

### Informed Consent

Informed consent was obtained from all individual participants included in the study.

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