The Effect of Loop Electrosurgical Excision Procedure on Future Pregnancy Outcome

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OBJECTIVE: **To estimate whether the loop electrosurgical excision procedure (LEEP) is associated with an adverse effect on the outcome of subsequent pregnancies.**

METHODS: **A retrospective cohort study was performed. The study group comprised women who had a LEEP in Halifax County between 1992 and 1999 and then had a subsequent singleton pregnancy of greater than 20 weeks of gestation with delivery at the IWK Health Centre in Halifax, Nova Scotia. The comparison group comprised women with no history of cervical surgery who were matched for age, parity, smoking status, and year of delivery. There were 571 women in each group. The primary outcome was rate of preterm delivery at less than 37 weeks of gestation. Secondary outcomes included delivery at less than 34 weeks and various neonatal and maternal outcomes. The effect of specific LEEP characteristics was analyzed separately.**

RESULTS: **Women who had a LEEP were more likely to deliver preterm overall (7.9% versus 2.5%; odds ratio [OR] 3.50, 95% confidence interval [CI] 1.90–6.95; $P < .001$) and to deliver preterm after premature rupture of membranes (PROM) (3.5% versus 0.9%; OR 4.10, 95% CI 1.48–14.09). The increase in delivery at less than 34 weeks was not statistically significant (1.25% versus 0.36%; OR 3.50, 95% CI 0.85–23.49; $P = .12$). Women with LEEP also delivered more low birth weight (LBW) infants (5.4% versus 1.9%; OR 3.00, 95% CI 1.52–6.46; $P = .003$). There were no differences in other neonatal or maternal outcomes. No association was found between the characteristics of the LEEP, including depth, and the rate of preterm delivery.**

CONCLUSION: **Loop electrosurgical excision procedure is associated with an increased risk of overall preterm delivery, preterm delivery after PROM, and LBW infants in subsequent pregnancies at greater than 20 weeks of gestation. Women who are considering future pregnancies should be counseled about these risks during informed consent for LEEP. (Obstet Gynecol 2005;105:325–32. © 2005 by The American College of Obstetricians and Gynecologists.)**

LEVEL OF EVIDENCE: II-2

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Many women who require treatment for cervical intraepithelial neoplasia (CIN) are in the reproductive age group. Thus, it is important to consider the potential negative effects of this treatment on future pregnancies. Several studies found an increased incidence of preterm delivery and an associated increase in low birth weight (LBW) infants after cone biopsy.[1–7] Newer ablative treatments, including cryotherapy, laser, and electrocautery, have not been shown to have a negative effect on pregnancy outcome.[8] Loop electrosurgical excision procedure (LEEP) was first described as a treatment for CIN by Prendiville et al in 1989.[9] Since its introduction into North American colposcopy clinics in the early 1990s, LEEP rapidly became the standard of care before there were long-term studies on future pregnancy outcome.

Upon review of the literature, only 6 individual studies were well designed to identify a potential increase in preterm delivery after LEEP, and none found a significant difference.[10–15] With a meta-analysis, Crane[16] demonstrated a significant increase in preterm birth after LEEP, as well as an increase in delivery of LBW infants. Given the relatively small sample sizes in previous individual studies, it is possible that there was not enough power to detect a significant difference in preterm birth after LEEP.

The objective of this study was to estimate whether LEEP is associated with an adverse effect on the outcome of subsequent pregnancies, primarily the rate of preterm delivery.

MATERIALS AND METHODS

A retrospective cohort study comparing pregnancy outcomes in women with and without exposure to LEEP

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was designed. Most of the data were acquired from 2 electronic databases.

The first database, the Provincial Cytology/Colposcopy Registry, is coordinated by the Nova Scotia Gynecological Cancer Screening Program and is based at the QEII Health Sciences Centre in Halifax, Nova Scotia. This is the tertiary care referral center for the surrounding county and the province. The Provincial Cytology/Colposcopy Registry database contains information about all women who have had colposcopy and treatment for CIN in Nova Scotia since 1992.

The second database, the Nova Scotia Atlee Perinatal Database, contains information about all pregnancies and deliveries in Nova Scotia carried beyond 20 weeks of gestation since 1988. Data are collected on maternal medical conditions, labor and delivery events, neonatal outcomes, and certain maternal characteristics. An ongoing quality assurance program and validation studies indicate that the information in the database is reliable.[17]

Ethics approval was obtained for a database and chart review at both the QEII Health Sciences Centre and the IWK Health Centre. The IWK Health Centre is the tertiary care referral center for obstetrics in the Maritime Provinces and the only maternity center in Halifax County.

Using the Provincial Cytology/Colposcopy Registry database, all women who had a LEEP in Halifax County between 1992 and 1999 were identified. By linking the Provincial Cytology/Colposcopy Registry database to the Atlee Database, all of those women who had subsequent pregnancies of greater than 20 weeks of gestation were identified. This database linkage was performed by matching identifying data, including name, health card number, and date of birth. Those women with a history of LEEP who still resided in Halifax County at the time of delivery and who delivered at the IWK Health Centre comprised the study group. Only the outcomes of their first delivery post-LEEP were included. The Atlee Database was also used to retrieve the comparison group, which comprised women from Halifax County with no history of cervical surgery who delivered at the IWK Health Centre beyond 20 weeks of gestation. They were matched for age (± 1 year), parity (nulliparous/parous), smoking status (yes/no/unknown), and date of delivery (± 1 year). Each control was randomly selected from a pool that included all who matched to a specific case. The medical records of all women in the comparison group were reviewed to ensure they had no history of cervical surgery to treat CIN.

Women were excluded from both groups if they had known major risk factors for preterm delivery, including previous preterm delivery and multiple gestations. Multiple gestations were analyzed separately. Women who had an indicated preterm delivery for maternal or fetal reasons were also excluded. Thus, our study included only women who delivered preterm after spontaneous labor with or without premature rupture of membranes (PROM).

The primary outcome was rate of preterm delivery, defined as delivery at less than 37 weeks of gestation. We also studied rate of delivery at less than 34 weeks and mean length of gestation. Secondary neonatal outcomes included number of LBW infants (< 2,500 g), mean birth weight, overnight neonatal intensive care unit (NICU) stay, and mean length of NICU stay. Overnight NICU stay included only those infants who stayed past midnight. Mean length of NICU stay was calculated using all infants who required admission to NICU. The potential effect on neonatal morbidity and mortality was assessed using a composite variable, which had previously been developed by selecting all of the appropriate severe neonatal morbidities from the Atlee Database, including grades 3 and 4 intraventricular hemorrhage and moderate-to-severe respiratory distress syndrome (Allen VM, Fahey TJ, Luther ER, Attenborough R, Farrell S. Maternal and infant morbidity and mortality associated with elective caesarean delivery versus attempted vaginal birth [abstract]. J Soc Obstet Gynecol 2003;25 suppl:S23). Maternal outcomes of interest included rates of PROM, preterm PROM, induction, and oxytocin augmentation, as well as mode of delivery and indication for cesarean delivery.

In a secondary analysis, the study group was analyzed to look for possible effects of specific characteristics of their LEEP, including size of the LEEP, number of passes, and presence of an endocervical pass. The pathology reports did not record volume; thus, size was measured by maximum diameter (length or width) and depth of the LEEP specimen. If a second pass was endocervical, the maximum depth was added to the depth of the endocervical pass. The effect of multiple procedures was considered by studying number of LEEPs per patient as well as history of other cervical procedures to treat CIN, including laser, cryotherapy, electrocautery, and cone biopsy. Finally, we assessed the length of time from LEEP to delivery.

Statistical analysis was performed with SAS 8.2 software (SAS Institute Inc, Cary, NC). Statistical significance was defined as $P < .05$. When determining whether the study and comparison groups differed on dichotomous outcomes, such as delivery before 37 weeks of gestation, we used the McNemar test as is appropriate for matched pairs.[18] A two-sided test was used. Continuous variables, such as mean birth weight, were compared using paired tests, Student t[19] or Wilcoxon signed rank test,[20] as appropriate. The gestational age at delivery in each group was compared using a Kaplan-Meier curve, and inferences about group effect were made using the log-rank test.

In the secondary analysis of LEEP characteristics, continuous variables, such as depth, were compared using the Wilcoxon or Savage test,[21] as appropriate, based on the distribution of values. The Savage test is a useful method of comparing exponential distributions, eg, the time between LEEP and delivery. The Fisher exact test was used to compare dichotomous variables, such as endocervical pass.

A sample size calculation was performed. The Atlee Database indicated that the incidence of preterm delivery in Nova Scotia was 5.7–6.6%, including multiple gestations.[22] Thus, a reasonable estimate of the incidence of preterm birth in uncomplicated singleton pregnancies would be 5%. A relative risk of 2, corresponding to a 10% preterm delivery rate among mothers with a history of LEEP, would be considered clinically significant. To have 80% power to detect such a difference between patients with and without LEEP with 95% confidence, the sample size should be at least 474 women in each group, using one-to-one matching.

RESULTS

Using the Provincial Cytology/Colposcopy Registry database, we found that 3,056 women had a total of 3,315 LEEP visits in Halifax County between 1992 and 1999. When the Provincial Cytology/Colposcopy Registry database was linked with the Atlee Database, 1,629 women were matched, indicating that they had a pregnancy and delivery at some time in their lives. Of the 1,629 matches, 876 (54%) had deliveries only before their LEEP. Of the 753 women with deliveries after their LEEP, 122 (16%) were excluded because they were not Halifax County residents. Additional exclusions were made for indicated preterm delivery, previous preterm delivery, and missing matching variables (ie, parity, age, delivery date), constituting another 50 cases in total. Thus, after appropriate exclusions, there were 581 women who had at least one delivery after their LEEP, 571 singleton, and 10 twin pregnancies. The multiple gestations were excluded from the primary analysis, leaving 571 women in the study group. We then retrieved a matched comparison group, consisting of 571 women.

Table 1 highlights the maternal characteristics for both groups. Fewer women were married or living common-law in the LEEP group. In the analysis, we controlled for marital status using logistic regression and found no effect on the primary outcome. The groups had similar rates of antenatal complications, except for severe pregnancy-induced hypertension (PIH), which was higher in the comparison group ($P = .004$).

Table 1. Maternal Characteristics of LEEP and Comparison Groups

	LEEP Group (n = 571)	Comparison Group (n = 571)
Age (y)	28.99	28.99
Parity		
Nulliparous	347 (60.8)	347 (60.8)
Multiparous	224 (39.2)	224 (39.2)
Smoking status		
Yes	148 (25.9)	148 (25.9)
No	388 (68.0)	388 (68.0)
Unknown	35 (6.1)	35 (6.1)
Marital status		
Single/other	196 (34.3)	149 (26.1)
Married	308 (53.9)	373 (65.3)
Common-law	67 (11.7)	49 (8.6)
Annual income measure (QAIPPE)*	2.83	2.97
Mean weight gain (kg)†	15.6	14.6
Antenatal complications‡		
None	416 (72.9)	402 (70.4)
PROM	102 (17.9)	97 (17.0)
Diabetes mellitus	13 (2.3)	20 (3.5)
Severe PIH/HELLP	3 (0.53)	16 (2.8)
Mild PIH	33 (5.8)	43 (7.5)
IUGR/macrosomia	10 (1.8)	11 (1.9)
Placenta previa	1 (0.18)	1 (0.18)
Placenta abruption	6 (1.1)	1 (0.18)
Polyhydramnios	3 (0.53)	0 (0)

LEEP, loop electrosurgical excision procedure; QAIPPE, quintile of annual income per person equivalent; PROM, premature rupture of membranes; PIH, pregnancy induced hypertension; HELLP, hemolysis, elevated liver enzymes, low platelets; IUGR, intrauterine growth restriction.

Data are presented as mean or n (%).

* This variable was developed by Statistics Canada[23] to provide an adjusted annual income based on census data averaged over all households in a postal code; 1 represents the lowest income and 5 the highest.

† n = 424, where both members of a pair had weight gain data available.

‡ Each patient may have more than one complication.

For the primary outcome of preterm delivery at less than 37 weeks, there were 44 women (7.9%) in the study group and 14 (2.5%) in the comparison group who delivered preterm. This was a statistically significant difference ($P < .001$), with an odds ratio (OR) of 3.50 (95% confidence interval [CI] 1.90–6.95). There were 7 women (1.25%) in the study group and 2 (0.36%) in the comparison group who delivered before 34 weeks; this difference was not statistically significant ($P = .12$), with an OR of 3.50 (95% CI 0.85–23.5). The difference in mean length of gestation was also not significant (Table 2).

Figure 1 demonstrates a Kaplan-Meier curve that compares the gestational ages at delivery of the 2 groups. The difference between the 2 curves, ranging from 33 to

Table 2. Gestational Age at Delivery for LEEP and Comparison Groups

	LEEP Group (n = 558)*	Comparison Group (n = 558)	Odds Ratio (95% CI)	*P*
Gestational age at delivery				
< 37 wk	44 (7.9)	14 (2.5)	3.50 (1.90–6.95)	< .001
< 34 wk	7 (1.25)	2 (0.36)	3.50 (0.85–23.5)	.12
Mean length of gestation (wk)	39.03	39.14	. . .	.71

LEEP, loop electrosurgical excision procedure; CI, confidence interval.
Data are presented as n (%) or mean.
* There were 13 pairs for which the gestational age was not provided for one member of the pair.

39 weeks, was not statistically significant ($P = .49$), with a hazard ratio of 0.948 (95% CI 0.82–1.10).

The rates of preterm delivery in multiple gestations were considered separately. There were 10 twin pregnancies in the LEEP group. A matched comparison group was selected in a 5:1 ratio. Five appropriate matches could not be found for each study patient, resulting in 35 women in the comparison group. There were 4 women (40%) in the LEEP group and 10 women (29%) in the comparison group who delivered before 37 weeks, which was not significantly different ($P = .49$), with an OR of 1.64 (95% CI 0.41–6.64). Two women in each group delivered before 34 weeks of gestation (OR 4.22, 95% CI 0.35–50.5; $P = .26$).

Women with a history of LEEP were more likely to deliver LBW infants, with 31 (5.4%) in the study group and 11 (1.9%) in the comparison group. This was significant ($P = .003$), with an OR of 3.00 (95% CI 1.52–6.46). The difference in mean birth weight was also statistically significant, with a mean weight of 3,432 g in the LEEP group and 3,495 g in the comparison group ($P = .046$). There were no differences in overnight NICU stay, mean length of NICU stay, severe neonatal morbidity and mortality, or overall perinatal mortality (Table 3).

There were 3 cases of perinatal mortality in the LEEP group, compared with no deaths in the comparison group ($P = .25$). The first case was an unexplained stillbirth at 41 weeks. The second death occurred in the early neonatal period secondary to a congenital anomaly after delivery at 36 weeks. The third case was a neonatal death due to extreme prematurity after delivery at 22 weeks, with a history consistent with cervical incompetence.

The groups were similar with respect to maternal outcomes, except for preterm PROM (Table 4). There were comparable rates of overall PROM, but there were more women with preterm PROM leading to spontaneous labor in the LEEP group: 20 (3.5%) versus 5 (0.9%), which was significant ($P = .004$), with an odds ratio of

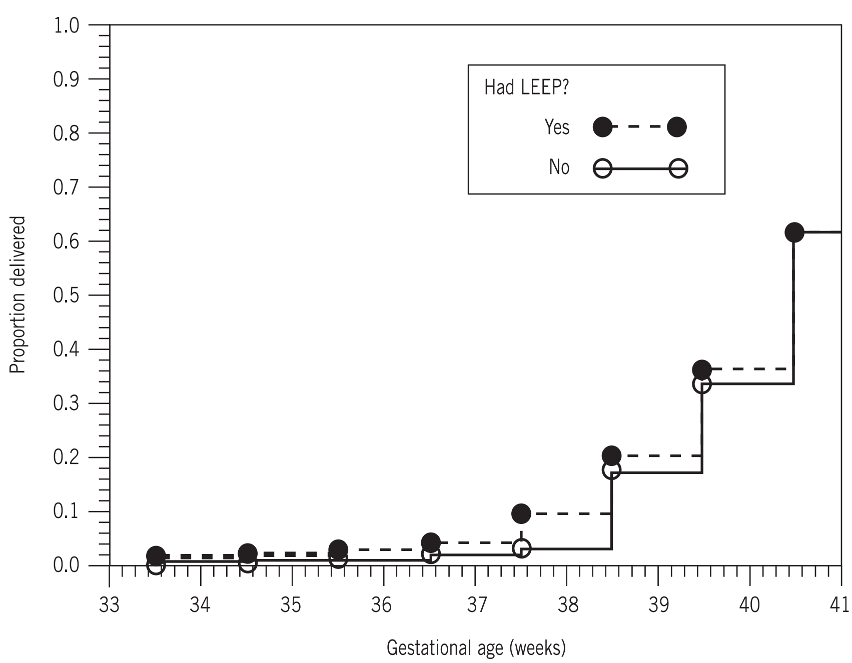

Fig. 1. Kaplan-Meier curve for gestational age at delivery. LEEP compared with No LEEP patients. LEEP, loop electrosurgical excision procedure.

Samson. Pregnancy Outcome After LEEP. Obstet Gynecol 2005.

Table 3. Neonatal Outcomes for LEEP and Comparison Groups

	LEEP Group (n = 571)	Comparison Group (n = 571)	Odds Ratio (95% CI)	*P*
Mean birth weight (g)	3,432	3,495	63 (1.2–125)*	.046
LBW infants	31 (5.4)	11 (1.9)	3.00 (1.52–6.46)	.003
Overnight NICU stay	78 (13.7)	66 (11.6)	1.20 (0.85–1.69)	.30
Mean length of NICU stay (d)	0.14	0.12	. . .	.34
Severe neonatal morbidity and mortality	12 (2.1)	8 (1.4)	1.50 (0.62–3.83)	.37
Perinatal mortality	3 (0.53)	0 (0)	. . .	.25

LEEP, loop electrosurgical excision procedure; CI, confidence interval; LBW, low birth weight; NICU, neonatal intensive care unit.
Data are presented as n (%) or mean.
* Mean difference in birth weight (95% CI).

4.10 (95% CI 1.48–14.09). There were no differences in rates of induction, augmentation, mode of delivery, or indication for cesarean delivery.

Women who delivered preterm after LEEP had the same LEEP characteristics as those who delivered at term (Table 5). There were no differences in diameter or depth of the LEEP, interval from LEEP to delivery, presence of an endocervical pass, or number of passes. We looked for a threshold effect for depth of the LEEP and found no increased risk for a depth greater than 10 mm, with a relative risk of 1.13 (95% CI 0.58–2.18; $P = .67$). There was also no increased risk in women who had more than one LEEP. Women who had LEEP plus any other procedure had a relative risk for preterm delivery of 1.82 (95% CI 1.08–3.08; $P = .05$).

DISCUSSION

This study shows a significant increase in preterm delivery at less than 37 weeks after treatment with LEEP. The rate of spontaneous preterm birth after LEEP was felt to be most relevant because LEEP should not affect the number of indicated preterm deliveries. The rates of spontaneous preterm delivery before 37 weeks were significantly different, with 7.9% in the LEEP group and 2.5% in the comparison group. This represents a number-needed-to-treat of 19; thus, for every 19 LEEPs performed, one patient will deliver preterm. The number of women with preterm PROM followed by preterm delivery was also significantly higher in the LEEP group: 3.5% versus 0.9%.

The overall preterm delivery rate of 2.5% in the comparison group is quite low, but this is to be expected given that this represents a group of truly low-risk women. After excluding women with previous preterm delivery, indicated preterm delivery, and multiple gestations, only low-risk singleton pregnancies were considered.

Six other retrospective cohort studies comparing pregnancy outcomes in women with and without history of LEEP have been published.[10–15] In our review of the literature, using the search terms "LEEP," "loop," "excisions," "pregnancy," and "preterm labor," no prior individual study showed a statistically significant difference in overall preterm delivery. Based on our sample size calculation, previous studies had a low probability of detecting a significant difference, with sample sizes ranging from 48 to 704 women.[10–15] However, Braet et al[11]

Table 4. Maternal Outcomes for LEEP and Comparison Groups

	LEEP Group (n = 571)	Comparison Group (n = 571)	Odds Ratio (95% CI)	*P*
PROM	102 (17.9)	97 (17.0)	1.06 (0.78–1.44)	.56
Preterm PROM	20 (3.5)	5 (0.9)	4.10 (1.48–14.09)	.004
Labor induction	155 (27.1)	136 (23.8)	1.15 (0.88–1.51)	.30
Augmentation*	101 (38.0)	83 (31.2)	1.39 (0.96–2.04)	.09
Mode of delivery				
Cesarean	125 (21.9)	117 (20.5)	1.09 (0.82–1.44)	.57
Vaginal	446 (78.1)	454 (79.5)	. . .	. . .
Indication for cesarean				
First stage arrest	30 (5.3)	32 (5.8)	0.93 (0.56–1.56)	.79
Second stage arrest	34 (6.0)	18 (3.2)	. . .	. . .
Other	61 (10.7)	67 (11.7)	. . .	. . .

LEEP, loop electrosurgical excision procedure; CI, confidence interval; PROM, premature rupture of membranes.
Data are presented as n (%).
* n = 266, number of pairs where both members of the pair went into spontaneous labor.

Table 5. Effect of LEEP Characteristics on Preterm Delivery (< 37 wk)

	N*	Preterm	Not Preterm	OR (95% CI)	*P*
Mean depth (mm)	561	6.50	6.84	...	.65
Mean diameter (mm)	564	18.27	20.24	...	.48
Interval from LEEP to delivery (d)	565	1,752	1,113	...	.30
Number of passes	535				
1		20	260	1.05 (0.76–1.46)	.87
> 1		20	235		
Endocervical pass	536				
Yes		8	79	1.26 (0.65–2.41)	.50
No		32	417		
Number of LEEPs	565				
1		41	475	0.77 (0.25–2.38)	1.00
> 1		3	46		
Other procedures†	565				
Yes		12	78	1.98 (1.06–3.69)	.05
No		32	443		

LEEP, loop electrosurgical excision procedure; CI, confidence interval.
Data are presented as mean or n.
* There were missing data for up to 36 patients; thus, n = 535 to 565.
† Other procedures include laser, cryotherapy, electrocautery, cone biopsy, or LEEP.

and Cruickshank et al[12] both demonstrated a doubling in preterm birth rate after LEEP, which may be considered clinically significant: 13% versus 5% and 9.4% versus 5.0%, respectively. In addition, Sadler et al[15] revealed an increase in preterm PROM leading to preterm delivery after LEEP. The systematic review by Crane,[16] which combined the results of 5 studies,[10–14] did show a difference in preterm delivery after LEEP: 12.5% versus 7.0%. When only the 3 studies that controlled for smoking were included, LEEP was still associated with increased preterm delivery: 13.7% versus 6.4%.

There was no difference in the rate of preterm delivery at less than 34 weeks, which is the upper limit for offering antenatal corticosteroids and tocolysis in most centers. Our findings suggest that, although more babies are delivered preterm after LEEP, they are mainly delivered between 34 and 37 weeks of gestation. This could still be clinically important because the incidence of certain complications, such as NICU admission, respiratory distress syndrome, and hyperbilirubinemia requiring treatment, are still higher in this gestational age group. Our sample size was not large enough to say with certainty that there is no significant difference in delivery before 34 weeks after LEEP. It is interesting that the odds ratio for delivery at less than 34 weeks was also 3.50, identical to the risk for delivery before 37 weeks, although the CI is much wider.

The number of LBW infants was significantly higher after LEEP: 5.4% versus 1.9%. This is also important because LBW infants have increased neonatal morbidity and mortality compared with larger infants.[24] Two other groups, Blomfield et al[10] and Braet et al,[11] demonstrated a significant difference in birth weight, although the former group had not controlled for smoking. The systematic review by Crane[16] also showed an increase in LBW infants after LEEP: 10.9% versus 6.2%. In our study, the increase in LBW infants did not translate into increased NICU admissions, length of NICU stay, or severe neonatal morbidity and mortality, although our study was not powered to investigate these rarer outcomes. The neonatal death after delivery at 22 weeks in the LEEP group may be considered clinically significant.

Previous studies have shown an increased risk of preterm delivery with increasing size of cone biopsy, including volume and depth of tissue removed.[6,7,15] This study found no difference in rate of preterm delivery based on characteristics of the LEEP, including depth. Ideally one would determine the volume of tissue removed using a fluid displacement technique,[25] but we were limited by the retrospective nature of the study. Pathology reports often provided length, width, and depth, but these measurements were not available in all cases. Also, there was estimation involved in patients with more than one pass. Thus, these measurements are relatively imprecise measures of the volume of cervical stroma removed.

One might anticipate an increased risk with multiple cervical procedures. This study found no increase in preterm delivery in women with multiple LEEPs, but there were only 49 women with more than one LEEP. The 90 women who had a combination of procedures to treat CIN had an increased risk of preterm delivery that bordered on statistical significance.

Given the current recommendation to treat high-grade lesions, it would not be appropriate to randomize patients to exposure to LEEP; thus, a cohort study is the best design for assessing the effect of LEEP on pregnancy outcome. Any retrospective study has inherent biases. Because the patients are not randomized, it is possible that the groups were different in other ways besides known CIN and subsequent LEEP, or that the CIN itself somehow precipitated the preterm delivery. This possibility was reduced by matching on factors known to be associated with preterm delivery, such as smoking status. There were differences in marital status between the groups, but logistic regression was used to control for marital status and found no effect on the primary outcome. There were more women in the comparison group with severe PIH. This should not affect the rate of preterm delivery because women with an indicated preterm delivery were excluded. It is possible that more of these babies may have been LBW or required NICU admission, but this would only strengthen our results. The 3 women with hydramnios in the study group all delivered at term.

The fact that most of our data are derived from databases also predisposes the study to limitations. First, there is some data missing. For the primary analysis, there were only 13 matched pairs (2.3%) with missing data. For the analysis of LEEP characteristics, up to 36 women (6.3%) had missing values. Second, there is some error in retrieval and entry of data. There are quality control measures in place,[17] but these did not involve specimen measurements.

Finally, we were limited by the nature of the databases. The Atlee Database contains only pregnancies beyond 20 weeks, which was a significant limitation. Second trimester losses have been found to be increased after cone biopsy,[7] and a difference in early second trimester losses may have been missed in this study. There was one late second trimester loss at 22 weeks in the LEEP group.

Why does LEEP increase the risk of preterm delivery? Perhaps resecting a large amount of cervical stroma decreases the structural integrity of the cervix and thus the ability to carry a pregnancy to term. Studies have shown that the length of cervix is normal on transvaginal ultrasonography after LEEP.[26] However, is the quality of the tissue that regenerates normal, or is it scar tissue that does not have the same functional properties?

The findings of this study are important because LEEP is now the most widely used treatment for CIN. Fortunately, the trend in recent years has been toward a more conservative approach, particularly in women who have not completed their childbearing. Loop electrosurgical excision procedure is still an appropriate choice for the first-line treatment of CIN. High-grade lesions, including CIN 2 and 3, should be treated as recommended by the American Society for Colposcopy and Cervical Pathology.[27] However, longitudinal studies reveal that 47–57% of CIN 1 will resolve spontaneously.[28,29] Thus, it may be appropriate to follow these patients carefully and treat them only if the lesions persist or progress to a higher grade. Our results also support a conservative 2-step approach in which a biopsy confirms the diagnosis and then treatment occurs at a subsequent visit, instead of a "see and treat" approach at one visit. Perhaps consideration should also be given to other treatment options.

When obtaining informed consent for LEEP, it is important to counsel women about the increased risk of preterm delivery in subsequent pregnancies. There may be a role for increased antenatal surveillance, such as serial digital cervical examinations or transvaginal ultrasonography, in women with a history of LEEP. Further studies are needed to determine the benefits of transvaginal ultrasonography in these patients.

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