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Comparison of effacement curve with dilatation curve for prediction of labor progression

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Abstract

Aim: This study was conducted to evaluate the ability of the effacement curve to predict fetal descent by comparing it to dilatation in order to improve the accuracy of the current partogram.

Method: We conducted an observational study of women who were admitted for vaginal delivery at Mobini Hospital, Sabzevar, Iran in 2015. During labor, dilatation and effacement were plotted in different graphs and then their association with fetal descent was separately evaluated and compared. This assessment was performed in two groups: primipara and multipara.

Results: From 1750 individuals, 503 primiparous and 512 multiparous women were eligible for the study. An adjusted generalized estimating equations multivariable model showed both dilatation and effacement had a significant relationship with fetal descent either in primipara or multipara. In primipara, the prediction value of effacement equalled dilatation (β,eff 0.29, $P < 0.001$; β,dil 0.30, $P < 0.001$). In multipara, the prediction value of effacement was obviously higher than dilatation (β,eff 0.45, $P < 0.001$; β,dil 0.27, $P < 0.001$). The strength of effacement to predict labor in multipara was clearly greater than in primipara (β,eff 0.45 and β,eff 0.29, respectively). The strength of dilatation to predict labor in multipara was comparable to primipara (β,dil 0.27 and β,dil: 0.30, respectively).

Conclusions: Regarding the acceptable predictive value of effacement, we believe considering effacement, dilatation and station curves altogether can improve the power of the existing partogram for the assessment of labor progression and detection of failure to progress.

Key words: dilatation, effacement, labor progress assessment, partogram.

Introduction

Cervical dilatation and effacement (shortening of its length) occur as a result of both uterine contractions and ripening processes[1,2] and are determined during labor management in every vaginal examination. Finding a reliable method to perfectly recognize abnormal conditions of labor progression has always been a challenge to physicians because prolonged labor can induce obstetric complications, such as postpartum hemorrhage, urogenital infection, vesicovaginal fistula, uterine rupture, increased risk of requiring a cesarean and also fetal injuries like asphyxia, cerebral palsy, skull fracture and death.[3,4] Friedman (1954) was the first to introduce the partogram with two components of cervical dilatation and fetal descent.[5] In 1972, Philpot and Castle made some modifications by adding alert and action lines,[6] and then other suggestions were offered for its improvement.[7–9] However, whether the existing partogram is sufficient for the prediction of labor progression has yet remained as a challenge.[10–12]

Although effacement is accepted as an acceptable variable to predict labor commencement and is one of

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the main factors that practically influences a physician's decision how to handle labor,[13–15] the current partogram lacks a graphical appearance of effacement. Therefore, we designed an effacement graph and compared it to a dilatation graph in terms of the association with fetal descent to estimate its ability to predict labor progression, with the aim of improving the existing partogram. We have found no similar graph in the literature.

Methods

This study was conducted in the maternity department of Mobini Hospital, Sabzevar, Iran, in 2015. After obtaining approval from the ethics committee and informed consent, women admitted for vaginal delivery were enrolled in this study. Demographic data, past obstetric and medical history and characteristics of the present labor, such as gestational age, membrane rupture, fetal station, cervical dilatation and effacement were added to a checklist. Interventions performed during labor, such as artificial amniotomy and the administration of analgesic agents and oxytocin were also recorded. A partogram containing an 'effacement curve' as well as the conventional dilatation and descent curves was used to monitor the progression of labor.

Women at gestational ages of 37–42 weeks, with singleton pregnancies and cephalic presentation either scheduled for or interested in vaginal delivery were included in study. Exclusion criteria consisted of uterine anomaly, cervical dilatation ≥6 cm at the time of admission, cervical fibroma and previous cervical injuries, such as cerclage and cryotherapy.

Midwives working in the maternity center monitored labor progression. They examined each participant at intervals of 2 h and drew cervical dilatation, effacement and descent curves in the partogram. Fetal station was assessed based on the presenting fetal part in relation to the ischial spine, described as zero. Above this point, the station was appointed from −3, meaning that the fetal head is located above the pelvic inlet but may float away during finger examination toward the lower parts −2 and −1. Below the ischial spine, it was determined as +1, +2 and +3. Whenever the fetal head became visible at the introitus, station +3 was considered.[16] We designed an effacement graph and added it to the current partogram. Its vertical axis was marked by effacement assessment from 0% to 100%, while its horizontal axis expressed the time in units of hours. For direct comparability, it was altered to conventional scales of '0 to 10', similar to dilatation. As fetal descent is an important step for the prediction of a successful vaginal delivery,[17] we evaluated effacement and dilatation in relation to descent to estimate the efficiency of effacement to predict labor progression.

Descriptive statistics were used to present the variables, the mean and standard deviation. A multivariable generalized estimating equation model was employed to calculate the adjusted regression coefficient between dilatation, effacement and fetal descent variables, while obstetric history, maternal age, gestational age, premature rupture of membranes, amniotomy, oxytocin use, analgesic and sedative use and neonatal birth weight were considered in analysis. We then evaluated the association between effacement and dilatation with fetal descent separately and finally, compared them to each other. The Huber–White sandwich variance estimation was used to calculate the 95% confidence interval and exchangeable correlation structure specified for a working correlation matrix. Because of the biological interaction between parity and station,[18] we stratified the analysis based on parity (primipara and multipara) in vaginal delivery. SPSS version 22.0 was employed to register sequential vaginal examinations and subsequent calculations. $P < 0.05$ was considered meaningful.

Results

From 1750 women who had a vaginal delivery, 503 primiparous and 512 multiparous women were eligible for the study. The mean age of participants was 29.2 (3.2) years. The results showed that in multipara, cervical effacement and dilatation were significantly associated with fetal descent (station) (adjusted regression coefficient [β] 0.45, $P < 0.001$; β 0.27, $P < 0.001$, respectively). The ability of effacement to predict descent progression was obviously greater than dilatation (β 0.45 vs. β 0.27, respectively) (Table 1).

In primipara, cervical effacement and dilatation were significantly associated with fetal descent (β 0.29, $P < 0.001$; β 0.30, $P < 0.001$, respectively) and the ability of effacement to predict descent was comparable to dilatation (β 0.29 vs. β 0.30, respectively) (Table 2).

The predictive value of effacement in multipara was obviously greater than in primipara (β 0.45 and β

Table 1 Generalized estimating equation modeling to predict fetal station in multipara women who delivered vaginally

Variables	Unadjusted model			Adjusted model		
	Coefficient	95% CI	*P*	Coefficient	95% CI	*P*
Cervical effacement (per 1 unit increase)	0.782	0.748–0.817	<0.001	0.457	0.364–0.550	<0.001
Cervical dilation (per 1 unit increase)	0.604	0.582–0.626	<0.001	0.279	0.209–0.348	<0.001
Gestational age						
>39 weeks	Ref	Ref		Ref	Ref	
37–39 weeks	0.658	0.561–0.755	<0.001	−0.141	−0.385 to 0.103	0.256
Premature membrane rupture						
No	Ref	Ref		Ref	Ref	
Yes	−0.239	−0.696 to 0.218	0.305	−0.05	−0.456 to 0.357	0.811
Amniotomy						
No	Ref	Ref		Ref	Ref	
Yes	0.239	−0.218 to 0.696	0.305	NC	NC	NC
Membrane rupture to delivery (hour)†	−0.019	−0.037 to −0.001	0.038	−0.001	−0.020 to 0.018	0.933
Oxytocin use						
No	Ref	Ref		Ref	Ref	
Yes	−0.205	−0.395 to −0.015	0.034	0.040	−0.147 to 0.226	0.676
Analgesic and sedative use						
No	Ref	Ref		Ref	Ref	
Yes	0.149	−0.062 to 0.359	0.166	0.422	0.218 to 0.626	<0.001
Neonatal birth weight						
>3400 g	Ref	Ref		Ref	Ref	
3080–3400 g (percentile 66%)	−0.093	−0.308 to 0.122	0.397	0.131	−0.074 to 0.337	0.211
<3080 g (percentile 33%)	0.090	−0.116 to 0.296	0.391	0.301	0.094 to 0.508	0.004
Abortion history (per one abortion increase)	−0.072	−0.241 to 0.097	0.404	−0.148	−0.292 to −0.004	0.044

†The time between membrane rupture and delivery (per 1 h increase) and NC, not calculated; Ref, reference category for estimation of regression coefficient in categorical variables.

0.29) (Fig. 1), but the predictive value of dilatation in multipara was almost equal to primipara (β 0.27 and β 0.30) (Fig. 2). Stratification analysis based on oxytocin use showed no significant difference between the groups with and without oxytocin regarding the ability of effacement to predict fetal station (*P* for interaction = 0.36) (Tables 1–2).

The fetal outcomes in all women who delivered vaginally were acceptable, and no significant difference between the groups (primipara and multipara) ($P > 0.05$) was observed.

Discussion

Labor is one of the most important phenomena in human life. As abnormal labor progression can lead to maternal and neonatal damage,[19,20] the proper management of labor is critical to achieve healthy generations.[19–21] We investigated the ability of the effacement curve to predict fetal descent, which is very important to make a judgment about the possibility of a successful vaginal delivery.[16,17] Our principal aim was to establish a modified partogram to assess labor progression more sensitively. We found that effacement is not only equal to dilatation for the prediction of fetal descent, but also that it is significantly superior in multiparous women. Logically, effacement begins when cervical tissue incorporates into the uterine segment (in the last weeks of pregnancy) and appears whenever the internal orifice of the uterus (os) is opened. This has been reported as a reliable sign of labor commencement, regardless of parity history.[14,20,22] Generally, the external os dilates later than the internal os in primipara, but in multipara the external os may be dilated before the opening of the internal os occurs. In other words, vaginal examination by midwives sometimes demonstrates cervical dilatation in the latter group whereas true labor has not yet started.[14] These physiologic presentations can explain why in our observations effacement was a more reliable method than dilatation to

Table 2 Generalized estimating equation modeling to predict fetal station in primipara women who delivered vaginally

Variables	Unadjusted model			Adjusted model		
	Coefficient	95% CI	*P*	Coefficient	95% CI	*P*
Cervical effacement (per 1 unit increase)	0.65	0.62–0.68	<0.001	0.29	0.23–0.35	<0.001
Cervical dilation (per 1 unit increase)	0.50	0.49–0.52	<0.001	0.30	0.26–0.34	<0.001
Spontaneous membrane rupture						
No	Ref	Ref		Ref	Ref	
Yes	−0.09	−0.34 to 0.16	0.49	−0.21	−0.49 to 0.07	0.14
Amniotomy						
No	Ref	Ref		Ref	Ref	
Yes	0.12	−0.13 to 0.38	0.34	−0.31	−0.68 to 0.05	0.09
Membrane rupture to delivery (hour)†	−0.01	−0.02 to 0.00	0.06	0.003	−0.009 to 0.015	0.63
Oxytocin use						
No	Ref	Ref		Ref	Ref	
Yes	−0.11	−0.33 to 0.10	0.31	−0.08	−0.29 to 0.12	0.43
Analgesic and sedative use						
No	Ref	Ref		Ref	Ref	
Yes	0.08	−0.13 to 0.31	0.43	−0.007	−0.17 to 0.15	0.93
Gestational age						
>39 weeks	Ref	Ref		Ref	Ref	
37–39 weeks	0.03	−0.19 to 0.26	0.78	0.12	−0.05 to 0.29	0.17
Birth weight						
>3400 g	Ref	Ref		Ref	Ref	
3080–3400 g (percentile 66%)	0.11	−0.12 to 0.34	0.34	0.05	−0.16 to 0.27	0.63
<3080 g (percentile 33%)	0.07	−0.16 to 0.30	0.53	0.14	−0.01 to 0.29	0.07
Abortion history (per one abortion increase)	−0.17	−0.37 to 0.02	0.09	−0.04	−0.23 to 0.13	0.61

†The time between membrane rupture and delivery (per 1 h increase). and Ref, reference category for estimation of regression coefficient in categorical variables.

predict labor, especially in multipara. Similarly, several studies have repeatedly demonstrated that cervical shortening (effacement) is a sensitive manifestation to predict preterm delivery.[13,14,23] Although effacement can be affected by maternal properties such as ethnicity, age, drug abuse and past obstetric history, it has remained the only method for the early detection of preterm labor.[13,24] An experimental follow-up of term pregnant women by ultrasonography revealed a good overall correlation between cervical length and its ability to differentiate true from false labor. 'Overall, a cervical length cutoff of ≤1.5 cm to predict true labor had the highest specificity (81%) and positive predictive value (83%)'.[25] Other researchers also advocate this hypothesis: 'a woman with similar dilation, who has advanced effacement, is nearly 2.5 times more likely to deliver within 7 days, and twice as likely to deliver within 14 days'.[15] In other words, follow-up of women with similar cervical dilatation, showed that those with greater progression of effacement delivered 2.5 times sooner than the others over seven day management, while more prolonged follow-up at 14 days showed the mentioned group delivered two times more, as well. These results confirm the importance of effacement for predicting labor progression.

Surprisingly, in spite of the emphasis on effacement in theory and practice, most researchers working with a partogram have merely introduced dilatation as a parameter to predict labor onset and progress.[5–9,18] Some believe that Friedman's partogram was revolutionary at the time of its production, but needs improvement after the changes in obstetric policies established in recent decades.[26] Indeed, after 20 years of experience in a crowded tertiary hospital, we also believe that the partogram is no longer sufficient to meet all the demands of today's obstetrical challenges.[18,26]

Although some investigators have focused on effacement as a prominent variable in labor assessment, they have not formally incorporated it into partograms. Huhn and Brost checked the examination

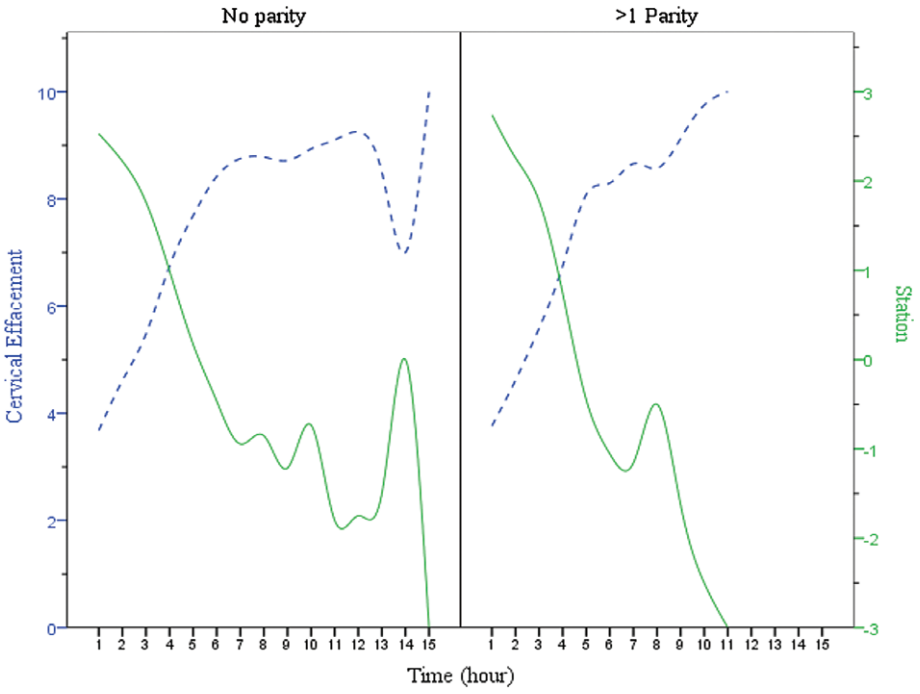

Figure 1 Cervical effacement versus station during visit time (per hour) in no parity and multipara patients.

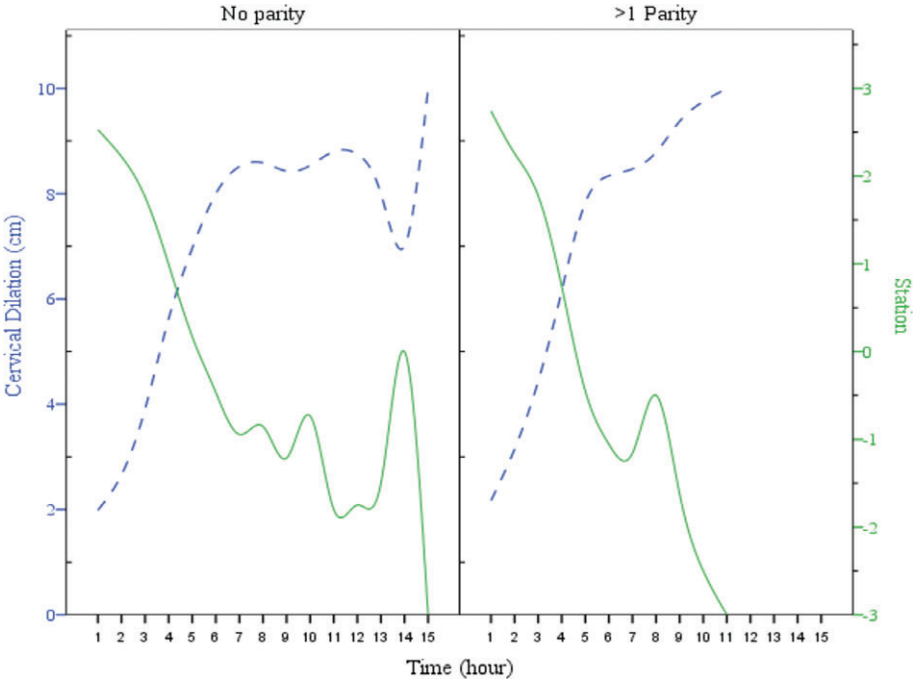

Figure 2 Cervical dilation versus station during visit time (per hour) in no parity and multipara patients.

records of different health staff, including residents and midwives, and reported that effacement estimation was less variable than dilatation among different examiners, which makes it a more reliable method to predict labor progression.[27] In their opinion, this was especially true for multiparous compared to primiparous women, and our results are consistent with this conclusion. We believe that the greater cervical pliability and pre-labor dilatation observed in multiparous women[14,28] makes dilatation less valuable than effacement in this group. In contrast, another study showed that dilatation and effacement

estimations were correct in 90% of cases, with approximately equal value.[22] Other investigators studying dilatation alone have proven its similar predictive value in primiparous and multiparous women,[28] and our findings are in agreement regarding dilatation.

Another study using a biexponential model for labor progress showed similar predictive values about the relationship between dilatation and effacement with station, regardless of parity.[28] In her investigation on primiparous women Langen also demonstrated the impact of effacement to predict labor progression, even in augmented cases, which is again consistent with our findings. Langen stated that it is very important to consider the two components together, especially to determine failure to progress.[29]

This study had some limitations. Clearly there are some differences between the examinations of various midwives, but this was a comparative study between dilatation and effacement, which was determined by one examiner at each visit and moreover, it is not possible to employ one examiner for all shifts.

In conclusion, we found that effacement has an acceptable predictive value for labor progress assessment in all women, but particularly in multiparous women. With respect to the authors who have already introduced or modified the partogram, we recommend adding an effacement curve to the existing partogram to improve its accuracy to detect failure to progress. Midwives can draw this concurrently with dilatation and station curves without spending significant extra time and consider these factors together to detect failure to progress. As this improved partogram is a simple and cost-effective tool to assess labor progression, it may be wise to suggest its application particularly in under-resourced countries with a large number of deliveries but without any electronic facilities to monitor labor.

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Disclosure

The authors declare that there are no potential conflicts of interest.

Author contributions

All authors have read and approved the final version of the manuscript.

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