# Vaginal Sonography of the Cervix for the Prediction of "Time to Delivery" in ART Twins Gestations

Adrian Shulman[1], Eric Jauniaux[2], Anna Holmes[2], Shlomo Maschiach[1], and Ron Maymon[2]

[1]*Department of Obstetrics and Gynecology, The Chaim Sheba Medical Center, Tel Hashomer, affiliated with the Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv, Israel*

[2]*Academic Departments of Royal Free and University College London, UCL Campus, London, UK*

The present study aimed to determine a reliable tool to estimate the interval time to delivery in assisted conception twin pregnancies. Mid-gestation cervical length was prospectively measured using transvaginal sonography (TVS) during routine antenatal care. Fifty-seven of 101 suitable women were longitudinally followed and two TVS measurements of their cervical length were obtained, first at approximately 24 weeks gestation and then at approximately 27 weeks gestation. The mean cervical length decreased from 37 ± 12mm at first measurement to 34 ± 11mm at the second one. A linear regression model was found between the time interval of the first ($R$ = 0.656, $p < 0.001$) and the second ($R$ = 0.435, $p < 0.001$) assessments and the week of delivery. The current data confirm that the length of the preserved segment of the cervix is an important indicator of its competence. A simple equation using the cervical length (mm) divided by 3 can predict mid gestation scan-to-delivery interval in twin gestation.

Twins represent about 1% of all births and 2% of all delivered infants, but they contribute about 12% to the overall perinatal morbidity rate, mainly because of premature delivery (Scott et al., 1999). It has been reported that among twin pregnancies, those of the highest risk for prematurity and associated neonatal morbidity and mortality are the ones conceived by assisted conception (Moise et al., 1998).

Transvaginal sonographic (TVS) assessment of the uterine cervix provides insight into the cervical status, including the likelihood of preterm delivery (Maymon et al., 1996; Roberts & Morrison, 1998). Therefore, TVS for cervical length measurement has been proposed in prenatal care, mainly for pregnancies at risk for preterm birth like twin pregnancies. However only few prospective studies have addressed this issue (Guzman et al., 2000; Imseis et al., 1997; Kushnir et al., 1995; Michaels et al., 1991; Souka et al., 1999). Guzman et al. have stated that TVS for cervical length measurement was not a good prediction of preterm delivery but rather a good prediction of delivery beyond various degrees of prematurity (as indicated by the high specificities) (Guzman et al., 2000). Shapiro et al. (2000) based on a retrospective chart review of patients with twin pregnancies concluded that a cervical length is predictive of preterm twin delivery ( < 28 and < 35 weeks of gestation) when TVS is performed before 30 weeks gestation.

Therefore, the aim of the current study was to devise an easily applicable formula for estimating mid gestation scan-to-delivery interval in ART twin pregnancies using TVS as a screening test.

## Materials and Methods

This observational study was carried out prospectively between January 1996 and May 1999. Twin gestations after ART treatment was enrolled in this study and served as a model. All the patients were referred for routine ultrasonographic surveillance between 19 to 30 gestational weeks. Gestational age was determined from the date of ovulation in cases of controlled ovarian stimulation or by the data of embryo transfer in the in vitro fertilization (IVF) cases, and thereafter confirmed by both first trimester crown-rump length (CRL) measurement and second trimester fetal biometry assessment.

Starting from late mid-gestation, those women were offered the opportunity of having periodic TVS assessment of their cervices on two occasions. The initial TVS for cervical measurement was carried out at approximately 24 weeks' gestation and the second at approximately 27 weeks' gestation. The nature of the test was explained, and only those parturient women who agreed had a longitudinal TVS measurement of their cervix. All the patients were asymptomatic of preterm contractures at the first TVS assessment. Exclusion criteria included either patients with cerclage or those who conceived higher order multiple pregnancies which were then reduced to twins. Patients delivered selectively by cesarean section before 34 weeks due to fetal or maternal complication were excluded as well. At the first visit, patient characteristics, including demographic data and previous obstetric and medical history, were obtained and recorded into a computerized database. Cervical length and characteristics were recorded in this database at the time of each visit. Information on the mode of delivery and the newborns' weights were retrieved from the hospital records or from personal interviews and registered in the same computerized database.

*Address for Correspondence: Dr A. Shulman, Department of Obstetrics and Gynecology, The Chaim Sheba Medical Center, Tel Hashomer, 52621, Israel. Email: adrian@netvision.net.il*



https://doi.org/10.1375/twin.5.4.255 Published online by Cambridge University Press

### Cervical Assessment

Our cervical assessment protocol was reported in depth elsewhere (Maymon et al., 2001). In brief, we aimed to obtain a sagittal view of the cervix and of the endocervical mucosa marking the cervical canal. The distance between the triangular area of echogenicity at the caudal tip close to the posterior wall of the upper vagina (the external os) and the "V" or the "U"-shaped notch at the end of endocervical mucosa (the internal os) was measured (Andersen et al., 1990). Both the external and internal ostium were identified at the two sides of the echogenic line (Figure 1).

Care was taken to avoid pressure on the cervix. The closed preserved portion of the cervical canal was measured, and if cervical funneling was present, its length was estimated as well (Figure 2). All measurements were performed by experienced sonographers using a transvaginal probe (General Electric, Synergy, or Aloka 1600, Tokyo, Japan) with a dynamic focus of 5 to 7 MHz and the values were recorded on hard copy.

**Figure 1**

Transvaginal sonography showing a closed internal and external cervical os.


**Figure 2**

Transvaginal sonography showing a preserved external cervical os, funneling of the internal os wish shortened cervical length.

### Statistical Analysis

Data are presented as mean ± standard deviation (*SD*). Statistical significance was determined using Student's *t* test. The prediction of the time interval to delivery according to the cervical length was obtained using a linear regression model. Homogeneity within the various groups of this study was assessed with the Chi-squared test. A probability < 0.05 was considered significant. Statistical analysis was performed in the statistical department of the Tel Aviv University using SPSS computer software.

## Results

Of the 110 pregnant women with twin gestation who were referred for routine ultrasonography, 8 were excluded due to the inappropriate timing of gestation ( < 19 weeks or > 30 weeks), and one had a missed co-twin. Of the remaining 101 women, two measurements of the cervical length were available for 57 of them. The mean week of delivery was 36 ± 3 (range 26–41). Multiple regression analysis between week of delivery and the patient's age, obstetric history, and previous uterine operations showed no statistical correlation (Table 1). Furthermore, we found that neither the presence of "cervical funneling" nor the lengths of the funnel segment correlated with scan-to-delivery interval. The only significant correlation was between the cervical length and the interval of time to delivery. The first TVS was performed at 24 ± 5 weeks of gestation and the second measurement at 27 ± 3 weeks of gestation. The mean cervical length was seen to have decreased with advancing gestation, from 37 ± 12mm at first measurement to 34 ± 11mm at second measurement. This observation provided no additional information in predicting the time of delivery. The time interval between the first TVS and week of delivery was positively and significantly correlated with the cervical length. The correlation was linear, with $R = 0.656$, $p < 0.001$ (Figure 3). This finding was confirmed independently by the linear correlation between the cervical length during the second TVS assessment and the interval of time to delivery ($R = 0.4563$, $p < 0.001$) (Figure 4). Based on a linear regression curve, we arrived at the following mathematical equation for expressing the relation between the cervical length (mm) and the interval of time to delivery (weeks): gap delivery = 0.07 + 0.314 × cervical length.

Since 0.07 is close to "0", the gestational gap can be directly calculated using the cervical length divided by 3. There was a significant difference ($p < 0.001$) in cervical length when it was calculated for patients predicted to deliver < 10 weeks and > 10 weeks from the time of first TVS assessment. The former had a mean cervical length of 27. ± 10mm vs 45.0 ± 10mm for the latter (sensitivity = 45% and specificity = 97.7%).

Furthermore we calculated the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) for a cervical length of up to 30mm or more than 40 mm and the probability to deliver in less than 10 or more than 13 weeks from the assessment. We calculated these figures only relatively to the first examination (Table 2).



https://doi.org/10.1375/twin.5.4.255 Published online by Cambridge University Press

**Table 1**

Patients' Data According to Obstetric History

| Obstetric history | Maternal age (mean ± *SD*) | Weight (g) 1st fetus (mean ± *SD*) | Weight (g) 2nd fetus (mean ± *SD*) | Delivery week (mean ± *SD*) |
|---|---|---|---|---|
| G0P0 (*n* = 45) | 28 ± 4 | 2459 ± 496 | 2288 ±496 | 37 ± 3 |
| G ≥ 1P 0 (*n* = 19) | 30 ± 4 | 2133 ± 394 | 2075 ± 616 | 35 ± 2 |
| G ≥ 1P ≥ 1 (*n* = 36) | 31 ± 3 | 2160 ± 618 | 2182 ± 614 | 36 ± 3 |

Note: G = gravity, P = parity

**Table 2**

The Sensitivity, Specificity, PPV and NPV for a Patient with a Cervical Length of Maximum 30 mm or Minimum 40 mm to Deliver in Less than 10 Weeks and Respectively More than 13 Weeks

| Cervical Length | ≤ 30 mm | ≥ 40 mm |
|---|---|---|
| Sensitivity | 67.5% | 82% |
| Specificity | 98.2% | 91.7% |
| PPV | 96.4% | 94.3% |
| NPV | 98.2% | 91.7% |

## Discussion

In the current study, we assessed the value of TVS as a screening test for spontaneous preterm delivery in ART twin gestation.

In agreement with Souka et al. (1999) the patient's age, zygoscity, previous obstetric history, and previous uterine operations had negligible contribution in predicting the week of delivery (Souka et al., 1999). Consequently, the other well-described associations between certain demographic characteristics, including obstetric history of preterm delivery, might be mediated by cervical changes that appear as cervical shortening.

Garite et al. (1990) have shown that pre-labor uterine activity in multiple gestation pregnancies is significantly higher than in singleton pregnancies from as early as 20 weeks' gestation (Garite et al., 1990). Thus, the onset of labor anytime during pregnancy may not necessarily be a sudden event, but rather a culmination of many silent uterine and cervical changes.

The rapid uterine growth in twin pregnancy is considered as a possible etiologic factor leading to subtle and/or overt uterine contractions. Although all our patients were free of uterine contractions, their cervical length shortened throughout gestation, thus challenging the classic concept of cervical competence of "all or none". The current findings point towards a mechanism of relative cervical incompetence resulting as a consequence of rapid uterine changes in otherwise asymptomatic twin gestations. Our data confirm that the preserved closed segment of the cervix may be regarded as the "functional cervix". In twin pregnancies, this segment is a good indicator of its competence, and

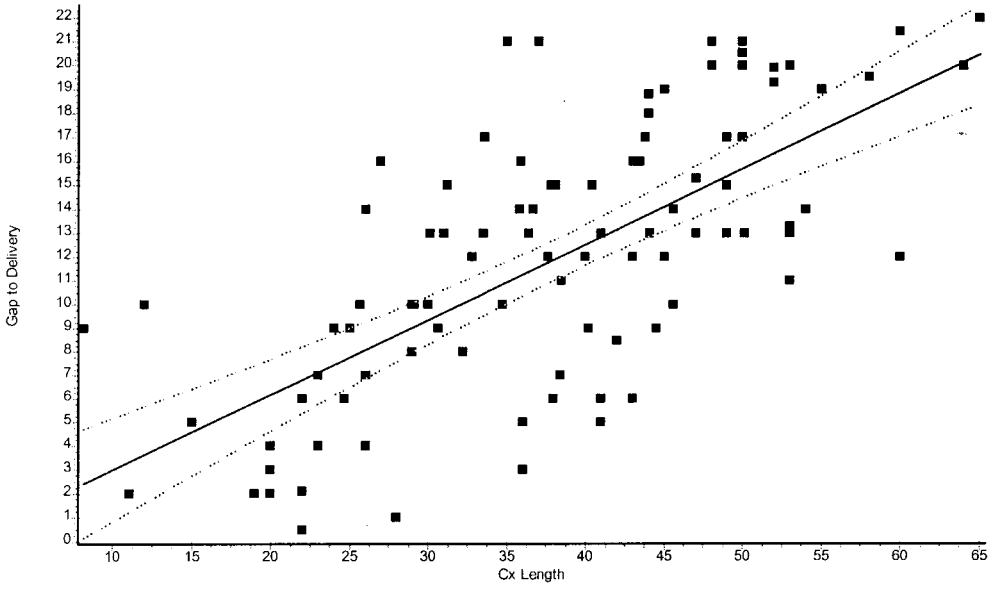


**Figure 3**

The linear correlation between the cervical length (mm) and the time interval to delivery (weeks) at the time of first assessment. Sample size and variability (standard deviation) were calculated to generate the 95% confidence interval for the population mean.



https://doi.org/10.1375/twin.5.4.255 Published online by Cambridge University Press

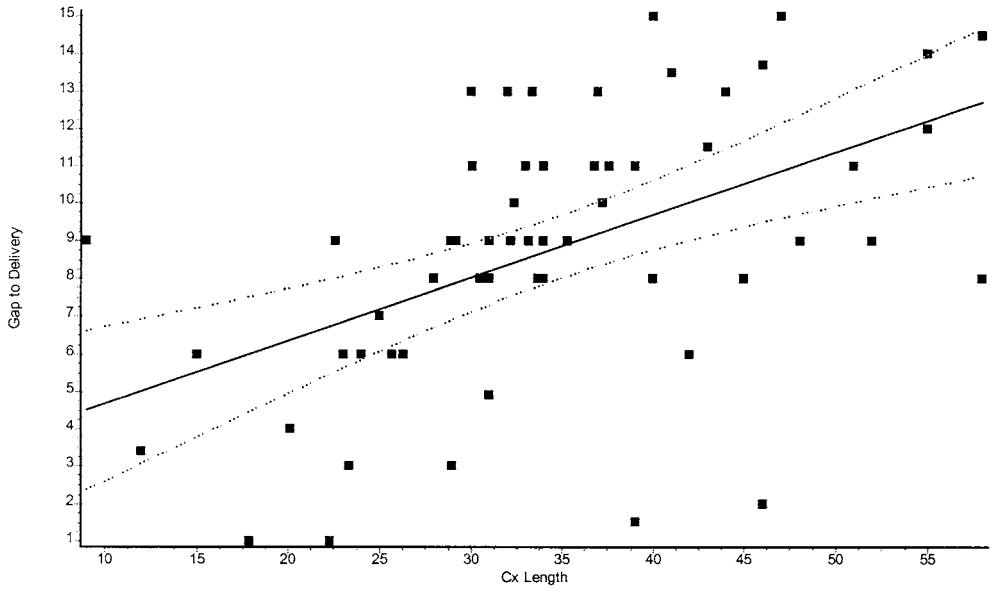


**Figure 4**

The linear correlation between the cervical length (mm) and the time interval to delivery (weeks) at the second assessment. Sample size and variability (standard deviation) were calculated to generate the 95% confidence interval for the population mean

the risk of premature delivery is inversely correlated with its length.

The present study quantified the association of cervical length with the time to delivery. The cervical lengths at 24 and 27 weeks currently recorded were similar to those reported by Iams et al. (1996) for singleton pregnancies at 24 weeks and, by extrapolation, at 28 weeks. We devised a mathematical equation to estimate the interval of time between examination and delivery. When this formula was applied to the findings reported by Souka et al. (1999) there was a good correlation between the cervical length at different gestational ages and the predicted time to delivery (Souka et al., 1999). Moreover, a single TVS examination at around 24 weeks of gestation was found to be sufficient for screening the patients at risk to deliver within the next 5 or 10 weeks in otherwise uncomplicated twin pregnancies. We contend that no additional information emerged from repeating the examination if the cervical length was ≥ 45 mm (Maymon et al., 2001). Contrary to Yang et al. (2000) we did not find a significant correlation between cervical funneling and cervical competence. Berghella et al. (1997) also reported cervical funneling < 25% not to be associated with an increased risk of preterm delivery. However, funneling of > 25% was found to be of clinical significance. A possible explanation for this finding is the technical difficulty for precise definition and measurement of cervical funneling. While the preserved internal os is easy to define by TVS, the "entire internal os" in cases of cervical funneling is difficult to establish. This is also because the constricted low uterine segment may mimic cervical funneling. Therefore, it may be difficult to identify the precise internal os landmark. Our results are in agreement with Guzman et al. (2000) who found that cervical length measurement revealed the optimal cut-off value for prediction of spontaneous preterm birth. Other cervical parameters, such as values for funneling and cervical index were found to be less accurate (Guzman et al., 2000). Thus, the measurement of cervical funneling length and its width were found to be less precise, and their integration in a mathematical formula was not applicable.

Although some authors believe that "it is doubtful that ultrasonographic measurement of cervical dilatation will replace the time-honored digital examination" (Bowes, 1995), this technique nevertheless offers substantial additional advantages (Maymon et al., 1996). The findings of the present study can assist the perinatologist treating parturient women with twins in deciding as when to start tocolytic drugs, according to which protocol, or, alternatively when to transfer her to a tertiary referral center with facilities for severely premature newborn(s). TVS for cervical length measurement in twin gestation is a simple and reproducible technique, with an inter-observer variability rate of only 5%–10% (Kushnir et al., 1995). We believe that it should be more commonly integrated into antenatal care, especially when the patient is at high risk for preterm delivery, as in twin pregnancy.

### Conclusion

In uncomplicated ART twin gestation, the functional preserved cervical length is a good indicator of its competence. A single TVS measurement at around 24 weeks' gestation appears to be adequate for screening patients at risk for premature twin delivery. The mean number of weeks expected for an uncomplicated twin pregnancy to continue is at least equal to the cervical length (in mm) divided by 3. The validation of our results in other high risk groups for premature delivery should be the subject of further studies.



https://doi.org/10.1375/twin.5.4.255 Published online by Cambridge University Press

## Acknowledgment

We thank Esther Eshkol for editorial assistance.

## References

Andersen, H. F., Nugent, C. E., Wanty, S. D., & Hayashi, R. H. (1990). Prediction of risk for preterm delivery by ultrasonographic measurement of cervical length. *American Journal of Obstetrics and Gynecology, 163,* 859–867.

Berghella, V., Tolosa, J. E., Kuhlman, K., Weiner, S., Bolognese, R. J., & Wapner, R. J. (1997). Cervical ultrasonography compared with manual examination as a predictor of preterm delivery. *American Journal of Obstetrics and Gynecology, 177,* 723–730.

Bowes, W. A. J. R. (1995). Editorial. *Obstetrics and Gynecology Survey, 50*, 18–19.

Garite, T. J., Bentley, D. L., Hamer, C. A., & Porto, M. L. (1990). Uterine activity characteristics in multiple gestations. *Obstetrics and Gynecology, 76,* 56S–59S.

Guzman, E. R., Walters, C., O'Reilly-Green, C., et al. (2000). Use of cervical ultrasonography in prediction of spontaneous preterm birth in twin gestation. *American Journal of Obstetrics and Gynecology, 183,* 1103–1107.

Iams, J. D., Goldenberg, R. L., Meis, P. J., et al. (1996). The length of the cervix and the risk of spontaneous premature delivery. *New England Journal of Medicine, 334,* 567–572.

Imseis, H. M., Albert, T. A., & Iams, J. D. (1997). Identifying twin gestations at low risk for preterm birth with a transvaginal ultrasonographic cervical measurement at 24 to 26 weeks' gestation. *American Journal of Obstetrics and Gynecology, 177,* 1149–1155.

Kushnir, O., Izquierdo, L. A., Smith, J. F., Blankstein, J., & Curet, L. B. (1995). Transvaginal measurement of cervical length: Evaluation of twin pregnancies. *Journal of Reproductive Medicine, 40,* 380–382.

Maymon, R., Herman, A., Jauniaux, E., Frenkel, J., Ariely, S., & Sherman, D. (2001). Transvaginal sonographic assessment of cervical length changes during triplets gestation. *Human Reproduction, 16,* 956–960.

Maymon, R., Shulman, A., Ariely, S., Halperin, R., Caspi, E., & Weinraub, Z. (1996). Sonographic assessment of cervical changes during pregnancy and delivery: Current concepts. *European Journal of Obstetrics, Gynecology and Reproductive Biology, 67,* 149–155.

Michaels, W. H., Schreiber, B. A., Padgett, R. J., Ager, J., & Pieper, D. (1991). Ultrasound surveillance of the cervix in twin gestations: Management of cervical incompetency. *Obstetrics and Gynecology, 78,* 739–744.

Moise, J., Laor, A., Armon, Y., Gur, I., & Gale, R. (1998). The outcome of twin pregnancies after IVF. *Human Reproduction, 13,* 1702–1705.

Roberts, W. E., & Morrison, J. C. (1998). Has the use of home monitors, fetal fibronectin, and measurement of cervical length helped predict labor and/or prevent preterm delivery in twins? *Clinical Obstetrics and Gynecology, 41,* 95–102.

Scott, J. R., Di Sain, P. J., Hammond, C. B., et al. (Eds.) (1999). *Danforth's obstetrics and gynecology* (8th ed.; p. 293). Philadelphia: Lippincot Williams & Wilkins.

Shapiro, J. L., Kung, R., & Barrett, J. F. R. (2000). Cervical length as a predictor of pre-term birth in twin gestations. *Twin Research, 3,* 213–216.

Souka, A. P., Heath, V., Flint, S., Sevastopoulou, I., & Nicholaides, K. H. (1999). Cervical length at 23 weeks in twins in predicting spontaneous preterm delivery. *Obstetrics and Gynecology, 94,* 450–454.

Yang, J. H., Kuhlman, K., Daly, S., & Berghella, V. (2000). Prediction of preterm birth by second trimester cervical sonography in twin pregnancies. *Ultrasound Obstetrics and Gynecology, 15,* 288–291.



https://doi.org/10.1375/twin.5.4.255 Published online by Cambridge University Press