Cervical Changes 2: USG Findings

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Abstract

Transvaginal sonography (TVS) is widely used in clinical settings to measure cervical length. The procedure is minimally invasive, and provides objective measurements that can predict the risk of preterm delivery. There are mainly two reasons to perform TVS to measure cervical length during pregnancy. First, it can be used to identify women who are at high risk of preterm delivery during the second trimester. Second, it can be used to evaluate the progression of threatened preterm delivery over time in women who are considered at high risk of preterm delivery based on her obstetric history. As a result, TVS enables early intervention for threatened preterm delivery. However, the measurement of cervical length for threatened preterm delivery has a high negative predictive value and low positive predictive value, particularly for low-risk women. As a result, patients may be overtreated if interventions are performed simply based on the observation of short cervical length. It is therefore important to perform additional examinations to accurately identify women at risk of preterm delivery.

Keywords

Cervical length · Transvaginal sonography · Cervical incompetence

7.1 Introduction

The measurement of cervical length by transvaginal sonography (TVS) is widely used clinically to determine the risk of preterm delivery at an early stage. Compared to pelvic examination, it provides a more objective measurement [1] and is less of a

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burden to patients as it is minimally invasive and can be performed within a relatively short period of time. There are two main reasons to perform TVS to measure cervical length. First, screening of low-risk women during the second trimester can identify those who may be at risk of preterm delivery [2]. Second, imaging of high-risk women can identify those with short cervical length at an early stage, enabling early interventions. In this context, women at high risk of preterm delivery include those who have a history of preterm delivery, as well as those who have had cervical conization, multiple pregnancy, and bacterial vaginosis.

There are also several limitations with the measurement of cervical length by TVS. Specifically, the method has a high negative predictive value and a low positive predictive value. Thus, it may be unnecessary to have patients be admitted or provide treatments such as intravenous infusion of tocolytic agents and cervical cerclage simply based on the finding of short cervical length.

In this manuscript, we review the methods to measure cervical lengths and discuss optimal timing for screening examination, implications of cervical length measurement in women at high risk of preterm delivery, and limitations of the cervical length measurement.

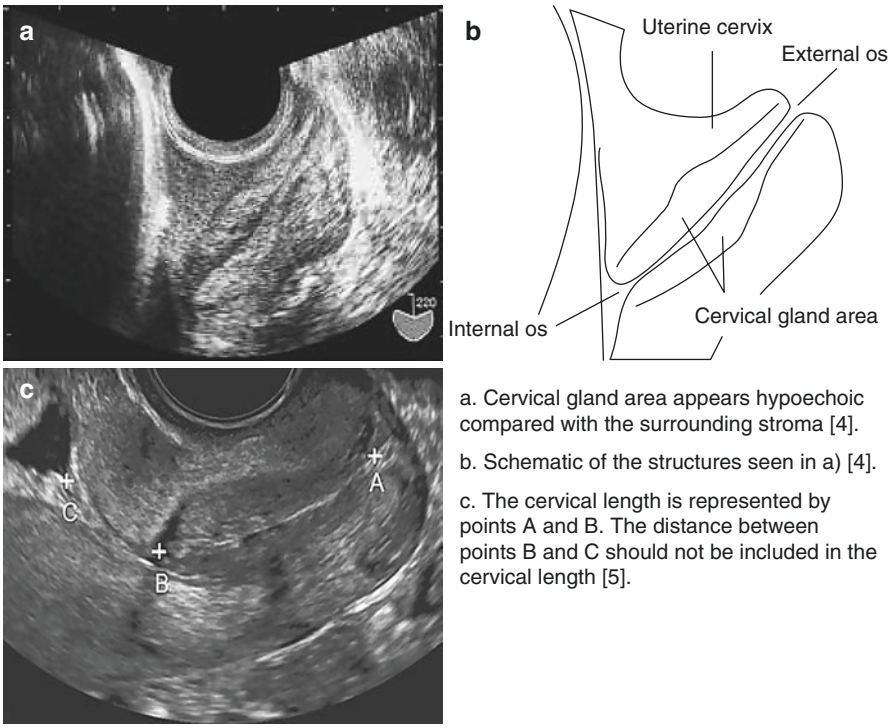
7.2 Measurement of Cervical Length

Table 7.1 summarizes the methods to measure cervical length [3]. The following are important considerations listed in Table 7.1.

1. The lower uterine segment and uterine cervix may deform easily due to the pressure from the surrounding tissues. In particular, pressure from the above may cause the anterior and posterior walls of the lower uterine segment to come in contact. Furthermore, histological internal os of the uterus may appear closed when it is in fact dilated. Therefore, the bladder must be empty.
2. The ultrasound probe should be inserted into the anterior vaginal fornix if possible. However, it may be difficult to do so due to the particular orientation of the cervix or if the cervix is displaced due to the presence of uterine fibroids. It is critical to obtain a longitudinal view of the center of the cervix in order to

Table 7.1 The methods to measure cervical length

Measure cervical length according to the following procedure:
1. Empty the bladder before measuring the cervical length
2. Insert the ultrasound probe into the anterior vaginal fornix, move it sideways, and obtain a longitudinal view of the cervix
3. Identify the internal os (identify the cervical canal and cervical gland)
4. Retract the probe as much as possible while maintaining the view of the cervical canal
5. Adjust the image size so that the cervical canal occupies approximately 50–75% of the image
6. Perform a pressure test and measure the shortest cervical length
7. Measurements should be obtained by manually tracing the structure or by dividing the structure into two segments and measuring the lengths of each segment in straight lines



a. Cervical gland area appears hypoechoic compared with the surrounding stroma [4].

b. Schematic of the structures seen in a) [4].

c. The cervical length is represented by points A and B. The distance between points B and C should not be included in the cervical length [5].

Fig. 7.1 Cervical gland area. (**a**) Cervical gland area appears hypoechoic compared with the surrounding stroma [4]. (**b**) Schematic of the structures seen in (**a**) [4]. (**c**) The cervical length is represented by points A and B. The distance between points B and C should not be included in the cervical length [5]

identify the cervical gland and cervical canal. If these structures are not identified, it would be difficult to identify women with short cervical length. Thus, it is important to image the entire length of the cervical canal.

3. The cervical gland appears hypoechoic (sometimes hyperechoic) in comparison to the surrounding stroma. Cervical length should not include the majority of the closed portion of the uterine isthmus; rather, it should be defined as the length between the external os and the opposite edge (histological internal os of the uterus) where the cervical gland region is visible on TVS (Fig. 7.1) [4, 5].
4. When the ultrasound probe is inserted deep into the vagina and pressure is applied to the cervix, the pressure from the probe may lead to compression as described above in (1). When this occurs, the probe has to be retracted.
5. The ultrasound image should be large enough to encompass the entire structure of the cervix. Accurate assessment is difficult when the image is too small.
6. The cervical length changes periodically due to physiological uterine contraction. Thus, the measurement should ideally be performed over 3–5 min. In fact, we often observe that cervical length shortens during uterine contraction, forming cervical funneling. However, if it is impractical to image for 3–5 min in a

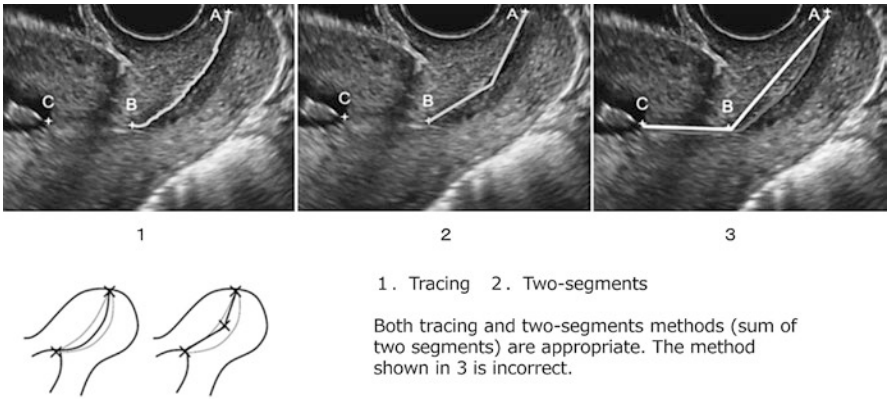


Fig. 7.2 Methods to measure cervical length [6]. (1) Tracing. (2) Two segments. Both tracing and two segments methods (sum of two segments) are appropriate. The method shown in (3) is incorrect

busy outpatient clinic, the examiner can manually replace either the fundus of the uterus downwards (caudal) or suprapubic region outwards (dorsal). This method artificially causes a dynamic change to the cervical canal, mimicking uterine contraction. The pressure should be applied for 20–30 s, and results in a shortening of the cervical length. The measurement of cervical length after dynamic shortening should improve the predictive accuracy for preterm delivery.

7. The cervical canal is curved in many patients. Thus, there will be some errors when the length is measured in a straight line. Instead, measurements should be obtained by manually tracing the structure or by dividing the structure into two segments and measuring the length of each segment (Fig. 7.2) [6]. Measurements may be obtained in a straight line when the cervical canal is shortened. In fact, a study demonstrated that the cervical canal was straight in all cases where it was <16 mm [7].

7.3 Optimal Timing to Screen for Cervical Length

In 1996, Iams et al. used TVS to measure cervical length at around 24 weeks and demonstrated that short cervical length is associated with a risk of preterm delivery at <35 weeks (Fig. 7.3) [2]. Specifically, the relative risks of preterm delivery compared with women with cervical length of over 40 mm were as follows: 1.98 for cervical lengths of ≤40 mm, 2.35 for ≤35 mm, 3.79 for ≤30 mm, 6.19 for ≤26 mm, 9.49 for ≤22 mm, and 13.99 for ≤13 mm. Furthermore, Guzman et al. performed a retrospective study and demonstrated that the measurement of cervical length between 15 and 24 weeks of pregnancy provides important information (Fig. 7.4) [8]. In this study, they demonstrated that women who were suspected of having cervical incompetence had shorter cervical length at around 15th week of pregnancy, and that the trend increased

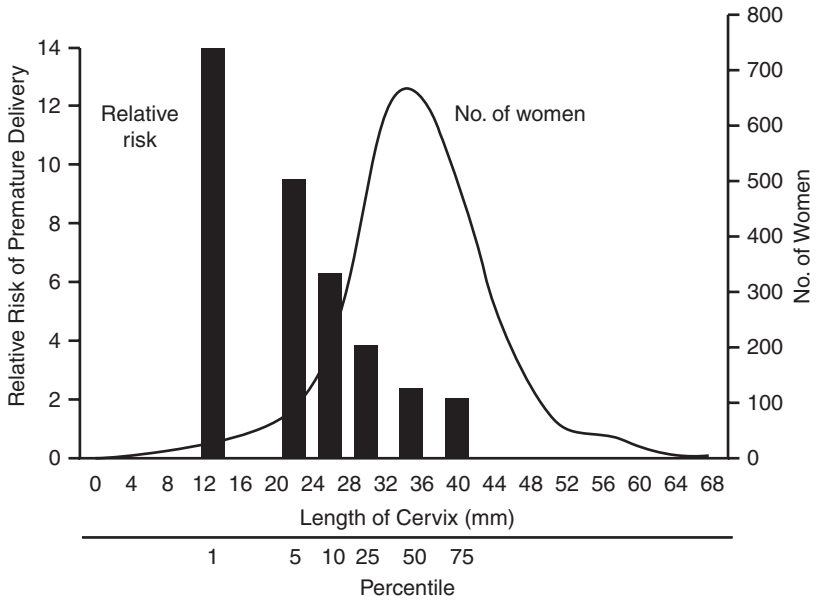


Fig. 7.3 Relative risk of premature delivery by the cervical length [2]

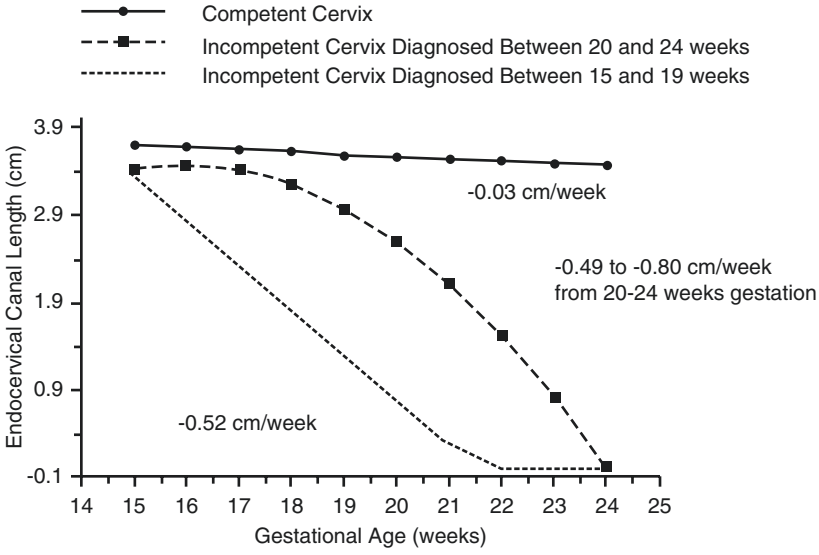


Fig. 7.4 Changes in the cervical length in patients with competent cervix and incompetent cervix (diagnosed between 15–19 weeks and 20–24 weeks) [8]]

significantly over time compared with those without cervical incompetence. There are many other studies to date that demonstrate the association between preterm delivery and cervical length in the second trimester, and the evidence suggests that short cervical length is a sensitive indicator of early-stage preterm delivery.

However, studies suggest that measurement of cervical length during the first trimester of pregnancy may not be informative. Antsaklis et al. performed a large-scale study including over 1000 women and demonstrated that only one of them had cervical lengths of <25 mm between 11 and 14 weeks of pregnancy [9]. In addition, Berghella et al. measured cervical length of 183 women before 14 weeks of pregnancy (10–13 weeks) who were at high risk of preterm delivery and demonstrated that only 5% of them had cervical lengths of <25 mm [10]. With the improved accuracy of ultrasonography systems, the cervical canal can now be imaged clearly during the first trimester to measure cervical length. As such, a recent study demonstrated that the clear distinction of the cervix and isthmus enables accurate evaluation of these structures, such that the measurement of cervical length in the first trimester of pregnancy is in fact useful in predicting preterm delivery [5].

There are few studies that report the usefulness of cervical length screening during the third trimester. In general, the cervical length of women is around 40 mm during the first to second trimester of pregnancy, and shortens to 25–30 mm after 32 weeks [11]. Thus, shortening of cervical length during the late weeks of pregnancy may be considered physiological. There is currently no consensus as to the usefulness of cervical length measurement to predict preterm delivery during this period.

Collectively, current consensus is that screening for cervical length is most optimally performed during the second trimester of pregnancy. Further evidence is required to justify screening for cervical length during the first trimester. Given that various complications including poor suckling, hypoglycemia, and apnea are seen in late preterm infants (born at 34-0/7 to 36-6/7 weeks) [12], it might be necessary to reconsider the value of screening for cervical length during the third trimester of pregnancy.

7.4 Cervical Incompetence

We have reviewed implications of screening for cervical length in women who are at low risk of preterm delivery. This section will focus on cervical incompetence, which poses a risk for preterm delivery.

Cervical incompetence has had various definitions, and there are currently no standard diagnostic criteria. Nevertheless, it is often defined as having indolent dilation of the cervical canal during the second trimester of pregnancy [13]. Risk factors for cervical incompetence include history of miscarriage or preterm delivery during the second trimester due to an unknown cause, as well as having cervical conization and trauma including cervical laceration.

Figure 7.5 illustrates a case of a patient with cervical incompetence. The presence of funneling was observed on ultrasound at 21 weeks. In this case, funneling is characterized by the invagination of the gestation into the cervical canal due to dilation of the internal os. Dilation of the internal os is correlated with the rate of

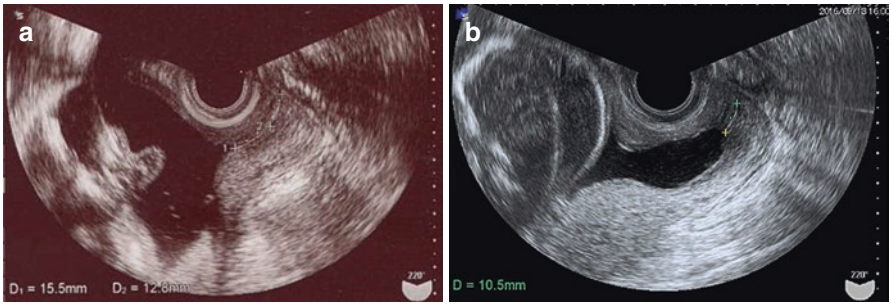


Fig. 7.5 A case of cervical incompetence. The patient was a 30-year-old woman who has had a previous child birth and a cervical conization. During her previous pregnancy, she underwent a prophylactic cervical cerclage and had a natural childbirth at 40 weeks. For this pregnancy, the patient was monitored over time as she did not wish to undergo cervical cerclage. The images represent the (**a**) at 18 weeks (cervical length: 28.3 mm) and (**b**) at 21 weeks (cervical length: 10.5 mm). The patient had a spontaneous rupture of the membrane at 24 weeks, requiring emergency cesarean section. She was unaware of uterine contraction, and cervical incompetence was suspected based on the clinical course

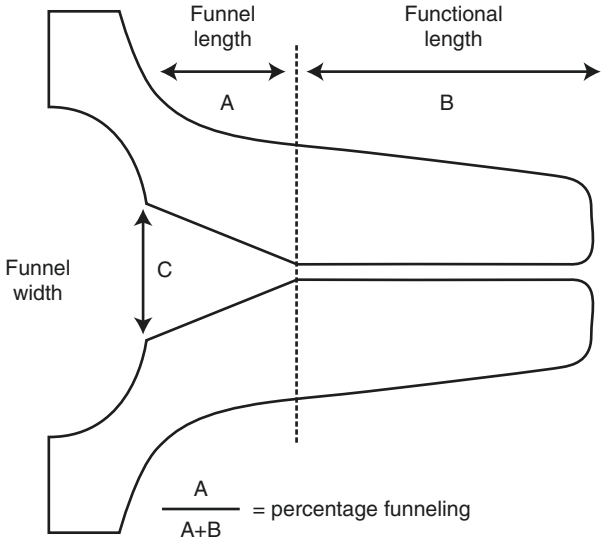


Fig. 7.6 Measurement of cervical length when funneling is present [14]

preterm delivery. According to the study by Berghella et al., preterm delivery rates were 10% in women with funneling of <25% and 70% in women with funneling of over 50% [14]. Figure 7.6 illustrates the method for measuring cervical length in women with dilated internal os. However, a study demonstrated that funneling is not an independent risk factor of preterm delivery, suggesting that the risk should be evaluated by measuring the shortened cervical length including the funneling [15]. In fact, funneling is sometimes observed in women with sufficient cervical length,

and these cases are not associated with an increased risk of preterm delivery. As described above, dynamic changes such as opening and closure of the internal os should be assessed to evaluate the risk of preterm delivery.

7.5 Limitations of Cervical Length Measurements

Romero et al. suggested that preterm delivery has various causes and should be considered a syndrome [16]. Specifically, they suggested that various factors including infections, hormone responsiveness, inflammatory response, environmental factors, lifestyle, and factors associated with the placenta and fetus interact with one another to cause preterm delivery.

Prediction of preterm delivery by cervical length can lead to false positive results in many cases. In addition, an appropriate approach to measure the length for those who present with short cervical length has not been well-established. Thus, there are limitations as to the reliability of the measurement.

The risk of preterm delivery should therefore be evaluated in combination with other methods. They include measurements of neutrophil elastase and fetal fibronectin in the cervical mucosa and concentrations of biochemical markers such as cytokines in the amniotic fluid and cervical mucosa [17, 18], as well as screening for bacterial vaginosis [19].

7.6 Conclusions

Following the study by Iams et al., screening for cervical length in low-risk women has become a common procedure. The procedure is effective to identify women who may be at high risk of preterm delivery. However, it might lead to unnecessary interventions in many cases as it has a low sensitivity for preterm delivery and has a low positive predictive value. Furthermore, the positive predictive value of cervical length measurement is relatively low in women who are at a high risk of preterm delivery. Therefore, cervical length measurement should be combined with other procedures such as measurements of other biomarkers and screening for bacterial vaginosis to improve the prediction of preterm delivery. As there are currently no standard treatment strategies, interventions for short cervical length should be determined in consultation with patients.

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