

# Cervical length at 22–24 weeks of gestation: comparison of transvaginal and transperineal-translabial ultrasonography

S. CICERO, C. SKENTOU, A. SOUKA, M. S. TO and K. H. NICOLAIDES

Harris Birthright Research Centre for Fetal Medicine, King's College Hospital Medical School, London, UK

**KEYWORDS:** Transvaginal sonography, Transperineal sonography, Cervical length, Preterm delivery

## ABSTRACT

**Objectives** To investigate the feasibility of measuring cervical length by transperineal or translabial sonography and compare the measurements obtained by this approach with those obtained transvaginally.

**Methods** In 500 women measurement of cervical length by translabial-transperineal sonography was attempted immediately before transvaginal scanning at 22–24 (median 23) weeks of gestation. In the first phase of the study, considered to be the learning period, 200 patients were examined and their results reviewed, before carrying out the second phase in which 300 patients were examined. A comparison was made of the patient acceptability of both techniques.

**Results** Cervical length was successfully measured transvaginally in all cases. In the first phase of the study cervical length was measured by translabial-transperineal sonography in 84% of the 200 patients but there was poor agreement with measurements obtained transvaginally and the 95% tolerance interval for paired observations was –11.0 mm to 16.1 mm. After audit of results it became apparent that the translabially-transperineally derived images were inadequate in more than half of the cases but in those with adequate paired measurements there was a very good agreement between the two and the 95% tolerance interval for paired observations was –5.8 mm to 5.2 mm. In the second phase of the study special attention was paid towards recording measurements of cervical length only in cases where both the internal and external os were adequately visualized. Successful measurements by translabial-transperineal sonography were obtained in 78% of cases and the 95% tolerance interval for paired observations was –5.8 mm to 6.1 mm. The degree of patient acceptability of the two methods was similar.

**Conclusions** The findings of this study suggest that at 22–24 weeks of gestation the cervix can be visualized adequately by translabial-transperineal sonography in about 80% of patients and the measurements of cervical length obtained by

this approach are very similar to those obtained by transvaginal sonography.

## INTRODUCTION

Transvaginal ultrasonographic assessment of cervical length at 22–24 weeks of gestation provides useful prediction of spontaneous early preterm delivery<sup>1,2</sup>. Cervical assessment can also be carried out by transabdominal and transperineal sonography and these alternative routes may be more acceptable to some women. However, transabdominal sonography fails to visualize the cervix in a high proportion of cases and in particular those with a short cervix<sup>3–6</sup>. Furthermore, successful visualization by transabdominal sonography requires a full bladder which falsely increases cervical length. Two studies comparing cervical length measurements by translabial or transperineal sonography with those obtained transvaginally have reported conflicting results. Kurtzman *et al.* examined 206 women at 14–34 weeks of gestation and successfully obtained paired transvaginal and transperineal measurements from all cases<sup>7</sup>. They reported that the correlation coefficient between the two measurements was 0.959, the estimated difference between the paired means was 1 mm and the 95% tolerance interval for paired observations was  $\pm 5$  mm. Owen *et al.* examined 102 women at 15–23 weeks of gestation and successfully obtained paired transvaginal and transperineal cervical length measurements from only 77 (75%) of the patients; they failed to obtain a measurement from 18 cases with the transvaginal approach and from 12 cases transperineally<sup>8</sup>. They reported that the correlation coefficient between the two measurements was 0.38 and, although the difference between the paired means was only 1.6 mm, in 33% of cases the intermethod difference in cervical length was  $\geq 20\%$ .

The aim of this study was to investigate further the feasibility of measuring cervical length by transperineal or translabial sonography and compare the measurements obtained by this approach with those obtained transvaginally.

Correspondence: Prof K. H. Nicolaides, Harris Birthright Research Centre for Fetal Medicine, King's College Hospital Medical School, Denmark Hill, London SE5 8RX, UK (e-mail: fmf@fetalmedicine.com)

Received 3-8-00, Revised 3-11-00, Accepted 5-12-00

## PATIENTS AND METHODS

At King's College Hospital, Greenwich Hospital and Lewisham Hospital, London, women attending for routine antenatal care are offered an ultrasound scan at 11–14 weeks' gestation and another at 23 weeks. The latter includes examination of the fetus and the option of having a transvaginal scan to measure cervical length as a screening test for spontaneous preterm delivery. Women with a short cervix ( $\leq 15$  mm) are given the option of participating in an ongoing multicenter randomized trial of cervical cerclage.

The women are asked to empty their bladder and are placed in the dorsal lithotomy position. Transvaginal sonography with a 5-MHz transducer (Aloka 1700; Aloka Co., Ltd, Tokyo, Japan; or ATL 3000; ATL, Bothell, WA, USA; or Corevision; Toshiba, Tokyo, Japan) is carried out by sonographers who have received The Fetal Medicine Foundation Certificate of Competence in Cervical Assessment (<http://www.fetalmedicine.com>). The probe is placed in the anterior fornix of the vagina and care is taken to avoid exerting undue pressure on the cervix, which may artificially lengthen the cervix. A sagittal view of the cervix is obtained and the sonolucent endocervical mucosa is used as a guide to the true position of the internal os, thereby avoiding confusion with the lower segment of the uterus. The calipers are used to measure the linear distance between the triangular area of echodensity at the external os and the V-shaped notch at the internal os<sup>9,10</sup>. Patient characteristics and ultrasound findings are recorded in a computer database. Gestational age is determined from the menstrual history and confirmed from the measurement of fetal crown–rump length at the first-trimester scan.

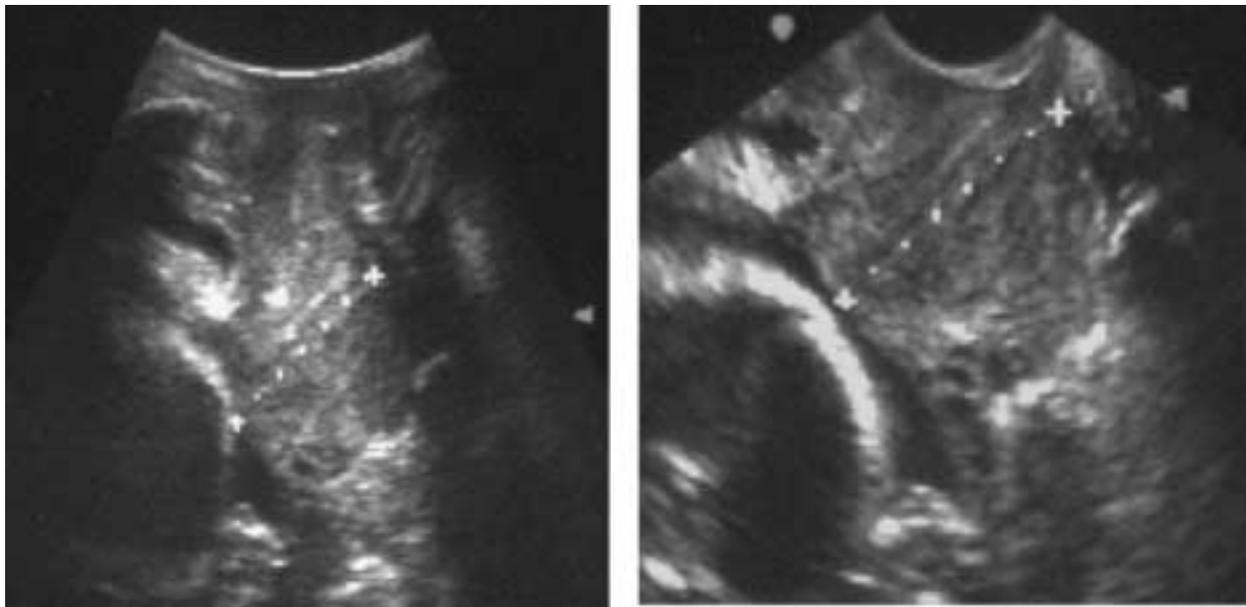
In a consecutive sample of 500 women undergoing transvaginal sonography informed consent was obtained for

cervical assessment by translabial-transperineal sonography immediately before the transvaginal examination (Figure 1). A 5-MHz curvilinear probe was inserted into a latex glove containing ultrasonographic gel. It was then covered with sterile water-soluble gel and placed sagittally between the labia majora. If the cervix could not be examined adequately the transducer was moved more caudally onto the perineum and was also rotated laterally or obliquely as necessary. All scans were carried out by one of three sonographers with extensive experience (more than 2000 scans) in transvaginal sonography. In each case the same sonographer carried out first the translabial-transperineal scan and then the transvaginal scan. The measurements on the screen were covered and after each examination thermal images with the calipers on the internal and external os were obtained for subsequent analysis.

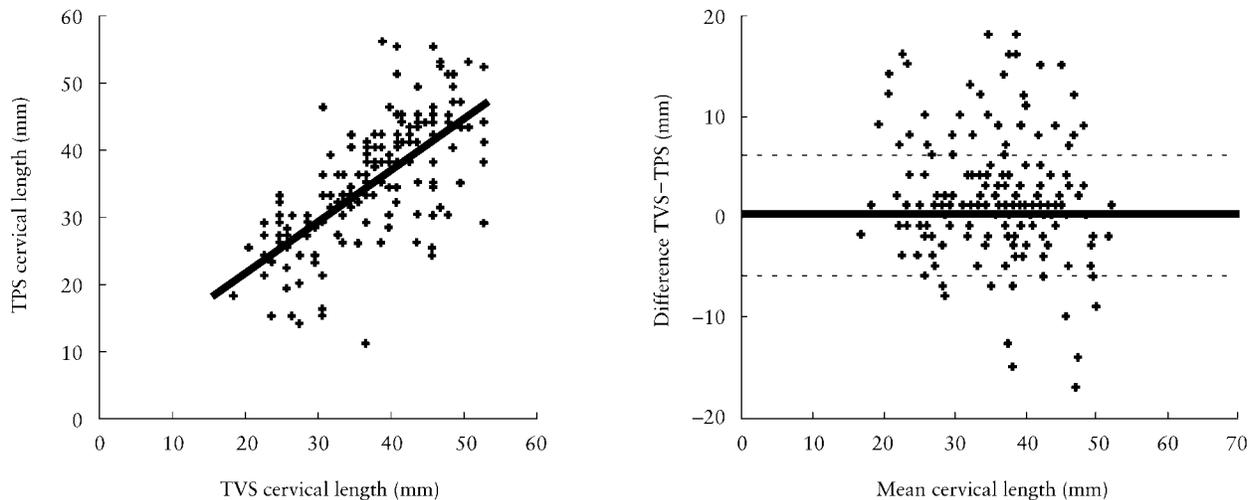
In the first phase of the study, considered to be the learning period, 200 patients were examined and their results reviewed, before carrying out the second phase in which 300 patients were examined.

### Patient acceptability

At the end of the ultrasound scans, 70 women that were examined consecutively were asked to complete a questionnaire aimed to compare the acceptability of the transperineal and transvaginal scans. They were asked to record the degree of discomfort (no discomfort, a little uncomfortable, uncomfortable, or very uncomfortable), embarrassment (not at all embarrassed, a little embarrassed, embarrassed, or very embarrassed) and pain (recorded on a linear scale measuring 10 cm with zero representing no pain and 10 representing extremely severe pain) caused by the two types of scans.



**Figure 1** In about 80% of patients the cervix can be visualized adequately by translabial-transperineal sonography (left) and the measurements of cervical length obtained by this approach are very similar to those obtained by transvaginal sonography (right).



**Figure 2** Association of cervical length measurements between translabial-transperineal and transvaginal sonography in the 168 patients with paired measurements in the first phase of the study of 200 patients (left). On the right is the Bland–Altman plot (difference between the transvaginal measurement and the translabial-transperineal measurement against the average between the paired measurement) in these patients. TVS, transvaginal sonography; TPS, translabial-transperineal sonography.

### Statistical analysis

Regression analysis was used to determine the significance of the association between transvaginally and translabially-transperineally obtained cervical lengths. The Bland–Altman plot, i.e. difference between the transvaginal measurement and the translabial-transperineal measurement against the average between the paired measurement, was performed and the 95% tolerance interval for paired observations was calculated<sup>11</sup>.

## RESULTS

In the 500 patients cervical assessment was carried out at 22–24 (median 23) weeks of gestation. There were 286 (57%) caucasians, 159 (32%) of Afro-Caribbean origin, 46 (9%) Asian and nine (2%) Oriental; the median age was 32 years (range 15–42 years), 75 (15%) were cigarette smokers, 34 (7%) admitted to drinking more than the equivalent of five glasses of wine per week, none was taking recreational drugs. One woman had a previous cone biopsy and four had laser treatment to the cervix. In terms of obstetric history, 169 (34%) patients had no previous pregnancies, 72 (14%) had one or more miscarriages and/or termination of pregnancy before 16 weeks of gestation, 213 (43%) had one or more term deliveries, with or without previous fetal losses before 16 weeks, 34 (7%) had at least one previous spontaneous preterm delivery, and 12 (2%) had at least one previous miscarriage or termination at 16–23 weeks.

### Phase 1

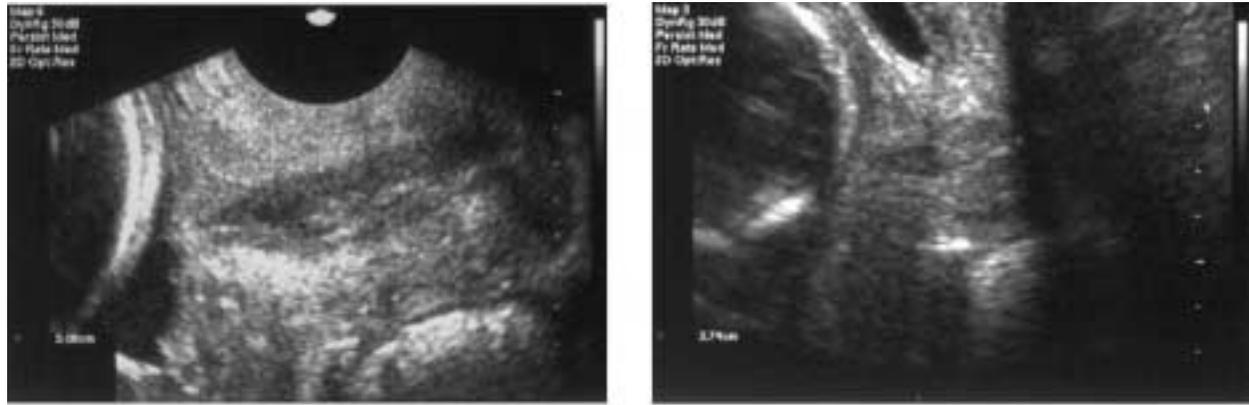
In the first phase of the study 200 patients were examined and cervical length was successfully measured transvaginally in all cases. In the translabial-transperineal approach it was not possible to visualize the cervix or both the internal and external

os in 32 (16%) cases. In the 168 cases with paired measurements there was a significant association between the two ( $r = 0.694$ ,  $P < 0.0001$ ; Figure 2). In the Bland–Altman plot the difference between the paired means was 2.5 mm and the 95% tolerance interval for paired observations was –11.0 mm to 16.1 mm (Figure 2).

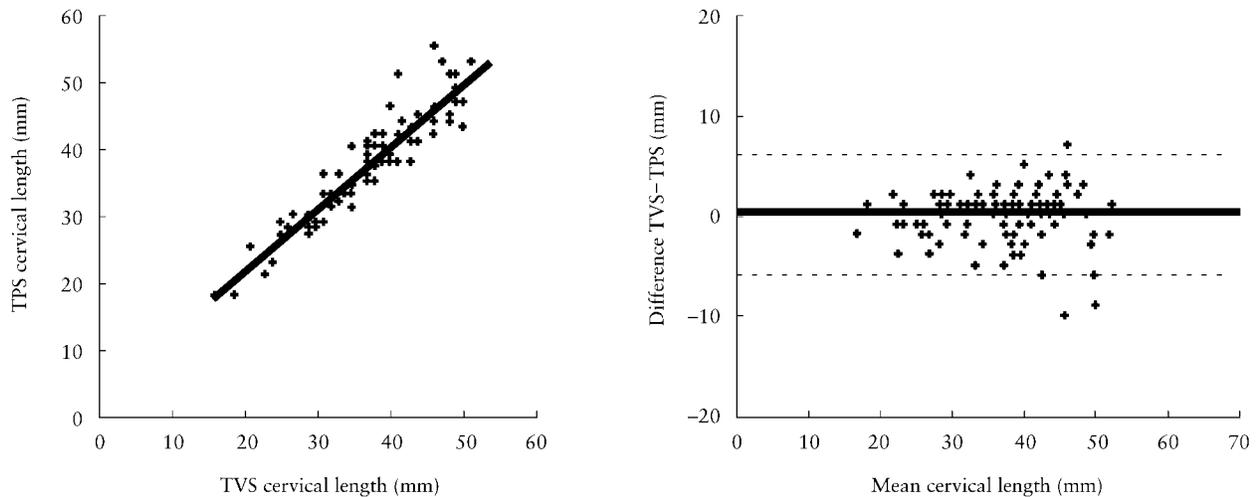
The thermal images were reviewed and with the transvaginal approach the three landmarks (endocervical mucosa, external and internal os) were adequately demonstrated in all cases. However, with the translabial-transperineal approach there were 110 (55%) cases in which it was not possible to visualize the cervix or the internal and/or external os were obscured by a sonolucent shadow (Figure 3). In the 90 cases with adequate paired measurements there was a significant association between the two ( $r = 0.944$ ,  $P < 0.0001$ ; Figure 4). In the Bland–Altman plot the difference between the paired means was –0.3 mm and the 95% tolerance interval for paired observations was –5.8 mm to 5.2 mm (Figure 4).

### Phase 2

In the second phase of the study 300 patients were examined and cervical length was successfully measured transvaginally in all cases. The distribution of cervical length was skewed to the left; the median and fifth centiles were 38 mm and 27 mm, respectively (Figure 5). In the translabial-transperineal approach it was not possible to visualize the cervix in 30 cases, the internal os in eight cases and the external os in 27 cases. There was no significant difference between the 235 cases with successful measurement and the 65 with no measurement in ethnic group (percentage of caucasians 55% and 66%, respectively;  $\chi^2 = 2.20$ ,  $P = 0.14$ ) or cervical length (median transvaginal measurement 39 mm and 38 mm;  $P = 0.71$ ), but the median body mass index (weight in kg divided by the height in m<sup>2</sup>) was significantly higher in the successful measurement group (24.2 vs. 22.6;  $P = 0.039$ ).



**Figure 3** In translabial-transperineal sonography the internal and/or external os are obscured by a sonolucent shadow in about 10% of cases. On the left is the cervix seen transvaginally and on the right with translabial-transperineal sonography there is shadowing of the external os.

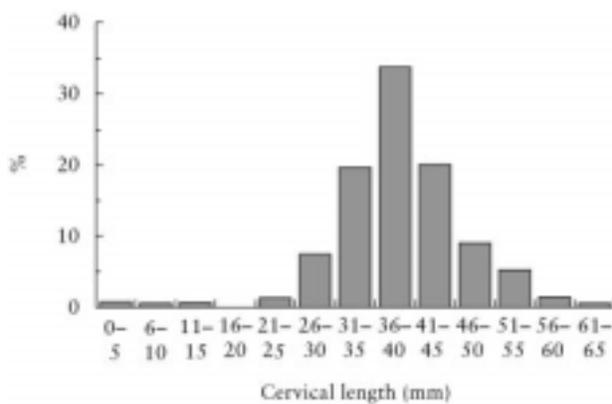


**Figure 4** Association of cervical length measurements between translabial-transperineal and transvaginal sonography in the 90 patients with adequate paired measurements in the first phase of the study of 200 patients (left). On the right is the Bland–Altman plot (difference between the transvaginal measurement and the translabial-transperineal measurement against the average between the paired measurement) in these patients. TVS, transvaginal sonography; TPS, translabial-transperineal sonography.

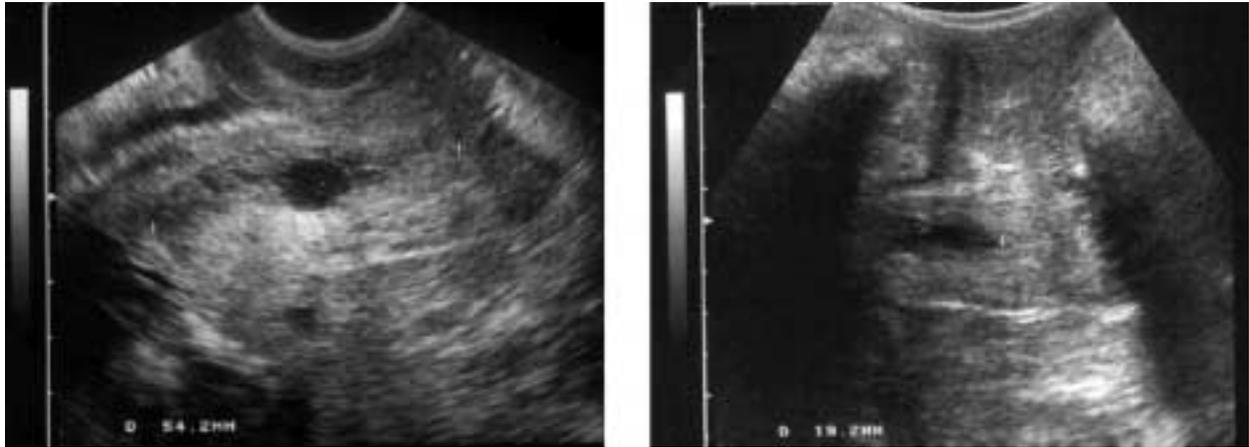
In the 235 (78%) cases in which cervical length was successfully measured by the translabial-transperineal approach there was one case in which transvaginal examination demonstrated that the translabial-transperineal measurement was wrong because an endocervical canal cyst was interpreted as funneling (Figure 6). In the 234 cases with appropriate paired measurements there was a significant association between the two ( $r = 0.934$ ,  $P < 0.0001$ ; Figure 7). In the Bland–Altman plot the difference between the paired means was 0.2 mm and the 95% tolerance interval for paired observations was  $-5.8$  mm to 6.1 mm (Figure 7).

**Acceptability study**

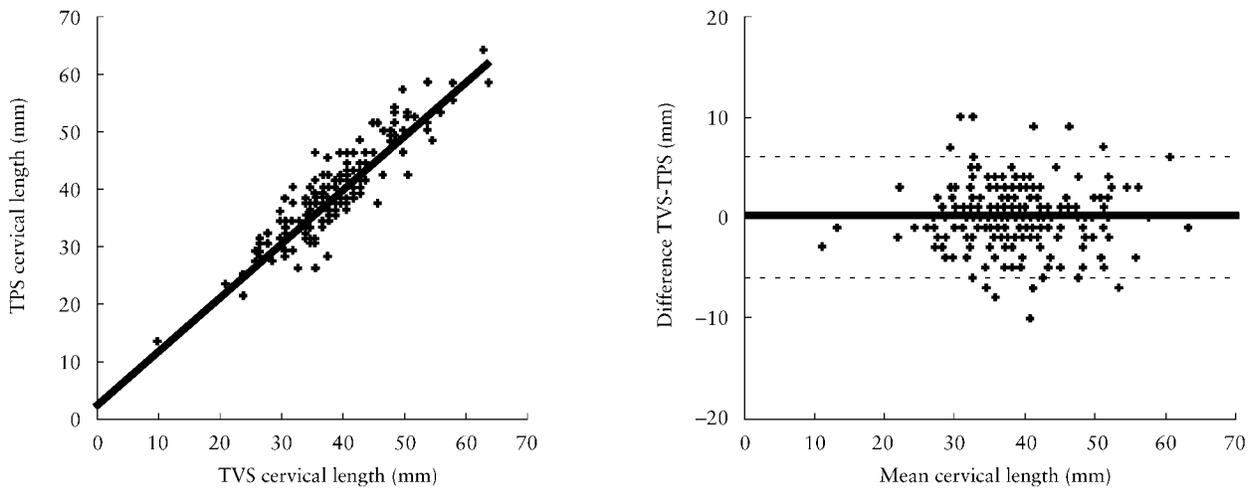
Translabial-transperineal sonography was associated with no or only mild discomfort in 95% of cases (compared with



**Figure 5** Distribution of cervical length, measured transvaginally, in the 300 patients examined in the second phase of the study.



**Figure 6** Endocervical canal cyst demonstrated by transvaginal sonography (left). In the translabial-transperineal examination the cyst was wrongly interpreted as funneling at the internal os (right).



**Figure 7** Association of cervical length measurements between translabial-transperineal and transvaginal sonography in the 234 patients with appropriate paired measurements in the second phase of the study of 300 patients (left). On the right is the Bland–Altman plot (difference between the transvaginal measurement and the translabial-transperineal measurement against the average between the paired measurement) in these patients. TVS, transvaginal sonography; TPS, translabial-transperineal sonography.



**Figure 8** The responses to the questions on degrees of discomfort and embarrassment after translabial-transperineal (□) and transvaginal sonography (■).

83% with the transvaginal approach;  $\chi^2 = 3.46$ ,  $P = 0.06$ ; Figure 8). With both methods 91% of patients recorded no or only mild embarrassment (Figure 8). For the degree of pain (represented on a linear scale of 0–10) the mean score with

translabial-transperineal sonography was 1.1 (range 0–9), compared with 2.4 (range 0–9) with the transvaginal approach (Wilcoxon signed rank test,  $P < 0.0001$ ).

### DISCUSSION

The findings of this study suggest that at 22–24 weeks of gestation the cervix can be visualized adequately by translabial-transperineal sonography in about 80% of patients and the measurements of cervical length obtained by this approach are very similar to those obtained by transvaginal sonography. In about 10% of cases the cervical canal cannot be visualized and in a further 10% of cases the external or internal os is obscured by a translucency that cannot be abolished despite vertical movement of the transducer from the translabial to the transperineal position, or by lateral angulation and rotation. We also found that translabial-transperineal sonography may be more acceptable to women than transvaginal sonography and more than 90% of women reported that the

procedure was associated with no or only mild discomfort and embarrassment.

In the first phase of the study, adequate attention was not paid to the effect of shadowing. It was thought that adequate measurements of cervical length could be obtained in about 85% of cases, but there was poor agreement with measurements obtained transvaginally and the 95% tolerance interval for paired observations was -11.0 to 16.1 mm. After audit of results it became apparent that the translabially-transperineally derived images were inadequate in more than half of the cases, but in those with adequate paired measurements there was very good agreement between the two and the 95% tolerance interval for paired observations was -5.8 to 5.2 mm. In the second phase of the study special attention was paid towards abolishing the translucency and recording measurements of cervical length only in cases where both the internal and external os were adequately visualized. Successful measurements were obtained in 78% of cases and the 95% tolerance interval for paired observations was -5.8 to 6.1 mm.

Our findings in the first phase of the study are in agreement with those of Owen *et al.*<sup>8</sup>, who failed to measure cervical length transperineally in only 12% of cases, but there was a poor correlation with transvaginally derived measurements and in one-third of their cases the intermethod difference in cervical length was  $\geq 20\%$ . In contrast, the results from the second phase are similar to those of Kurtzman *et al.*<sup>7</sup> who reported a very good correlation between transvaginal and transperineal measurements and 95% tolerance interval for paired observations of  $\pm 5$  mm. The difference between our studies is that Kurtzman *et al.* successfully obtained paired transvaginal and transperineal measurements from all cases<sup>7</sup>, whereas in our study this was possible in only 78% of cases.

The implications of our findings are that in a high proportion of patients the cervix can be examined by translabial-transperineal sonography and in such cases the measurements of cervical length obtained by this approach are reliable. Consequently, in patients objecting to transvaginal sonography and in those with ruptured membranes, where vaginal examination may be contraindicated, translabial-transperineal sonography may offer an acceptable alternative method for

cervical assessment. However, it is imperative that sonographers undertaking translabial-transperineal scanning receive extensive training to avoid the mistakes illustrated in the first phase of our study.

## ACKNOWLEDGMENT

This study was supported by a grant from The Fetal Medicine Foundation (Charity No. 1037116), London, UK.

## REFERENCES

- 1 Iams JD, Goldenberg RL, Meis PJ, Mercer BM, Moawad A, Das A, Thom E, McNellis D, Copper RL, Johnson F, Roberts JM. The length of the cervix and the risk of spontaneous delivery. *N Engl J Med* 1996; 334: 567-72
- 2 Heath VCF, Southall TR, Souka AP, Elisseou A, Nicolaides KH. Cervical length at 23 weeks of gestation: prediction of spontaneous preterm delivery. *Ultrasound Obstet Gynecol* 1998; 12: 312-7
- 3 To MS, Skentou C, Cicero S, Nicolaides KH. Transvaginal and transabdominal ultrasonography of the uterine cervix at 23 weeks of pregnancy: technical aspects I. *Ultrasound Obstet Gynecol* 2000; 15: 292-6
- 4 Anderson HF. Transabdominal and transvaginal ultrasonography of the uterine cervix during pregnancy. *J Clin Ultrasound* 1991; 19: 77-83
- 5 Bowie JD, Andreotti RF, Rosenberg ER. Sonographic appearance of the uterine cervix in pregnancy: the vertical cervix. *AJR Am J Roentgenol* 1983; 140: 737-40
- 6 Podobnik M, Bulic M, Smiljanic N, Bistricki J. Ultrasonography in the detection of cervical incompetency. *J Clin Ultrasound* 1998; 13: 383-91
- 7 Kurtzman JT, Goldsmith LJ, Gall SA, Spinnato JA. Transvaginal versus transperineal ultrasonography: a blinded comparison in the assessment of cervical length at midgestation. *Am J Obstet Gynecol* 1998; 179: 852-7
- 8 Owen J, Neely C, Northen A. Transperineal versus endovaginal ultrasonographic examination of the cervix in the midtrimester: a blinded comparison. *Am J Obstet Gynecol* 1999; 181: 780-3
- 9 Anderson HF, Nugent CE, Wanty SD, Hayashi RH. Prediction of risk for preterm delivery by ultrasonographic measurement of cervical length. *Am J Obstet Gynecol* 1990; 163: 859-67
- 10 Sonek J, Shellhaas C. Cervical sonography: a review. *Ultrasound Obstet Gynecol* 1998; 11: 71-8
- 11 Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986; 1: 307-10