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ORIGINAL ARTICLE

# Transperineal ultrasonography in stress urinary incontinence: The significance of urethral rotation angles

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**KEYWORDS**

Urethral rotation angles;
Transperineal ultrasonography;
Stress urinary incontinence

**ABBREVIATIONS**

α angle, anterior urethral angle;
β angle, posterior urethral angle;
ROC, receiver operating characteristic;

**Abstract** ***Objective:*** To assess, using transperineal ultrasonography (TPUS), the numerical value of the rotation of the bladder neck [represented by the difference in the anterior (α angle) and posterior urethral angles (β angle)] at rest and straining, in continent women and women with stress urinary incontinence (SUI), to ascertain if there are significant differences in the angles of rotation (Rα and Rβ) between the groups.

***Patients, subjects and methods:*** In all, 30 women with SUI (SUI group) and 30 continent women (control group) were included. TPUS was performed at rest and straining (Valsalva manoeuver), and the threshold value for the urethral angles (α and β angles) for each group were estimated. The degree of rotation for each angle was calculated and was considered as the angle of rotation.

***Results:*** Both the α and β angles were significantly different between the groups at rest and straining, and there was a significant difference in the mean increment in the value of each angle. Higher values of increment (higher rotation angles) were reported in the SUI group for both the α and β angles compared with those of the control group [mean (SD) Rα SUI group 19.43 (12.76) vs controls 10.53 (2.98)°; Rβ SUI group 28.30 (12.96) vs controls 16.33 (10.8)°; $P < 0.001$].

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(S)UI, (stress) urinary incontinence; (TP)US, (transperineal) ultrasound/ ultrasonography

***Conclusion:*** Urethral rotation angles may assist in the assessment and diagnosis of patients with SUI, which may in turn reduce the need for more sophisticated urodynamic studies.



## Introduction

Urinary incontinence (UI) is a common condition associated with a significant burden on quality of life [1]. Bladder neck hypermobility is well known to be closely related to stress UI (SUI). The pathological basis of SUI is probably due to defective anatomical support of the bladder neck and proximal urethra, with resultant hypermobility and descent beyond the intra-abdominal transmission zone [2]. Transperineal ultrasonography (TPUS) has been introduced in the diagnostic evaluation of SUI; its role is being intensely discussed, as it has been shown to be a sensitive method for assessing urethral mobility [3]. Several parameters and angles are being used for the evaluation of urethral mobility and research continues to determine the most valid ultrasound (US) technique and measurements [4]. Bladder neck mobility has been related to the functional integrity of the structures surrounding the proximal urethra, at TPUS abnormal movement of the bladder neck with a cough or Valsalva manoeuvre can be visualised [5]. Upon straining, the proximal part of the urethra may exhibit a rotational movement in a postero-inferior direction. The extent of this movement can be assessed by measuring the angles of inclination between the proximal urethra and some other fixed axis. In this respect, the anterior urethral angle ($\alpha$ angle; drawn between the axis of the proximal urethra and the central axis of the symphysis pubis) and the posterior urethrovesical angle ($\beta$ angle; formed between a line drawn at a tangent to the proximal half of the urethra and a line at a tangent to the lowermost back aspect of the bladder base), are the frequently used parameters [6,7]. Publications on urethral angles and other parameters of urethral mobility have presented widely differing measurements for 'normal' and 'abnormal' bladder neck descent and urethral angles [8]. These variations can be related to differences in the US technique (transperineal or transvaginal), the variability of bladder filling, and the difference in the quality of the Valsalva manoeuver performed by the patient. All of the published studies have mainly concentrated on the static and dynamic threshold values of the urethral angles and the degree of bladder neck descent but, to our knowledge, none have dealt with the degree of variation in the urethral angles in continent women and women with SUI.

The present study aimed to evaluate the numerical value of rotation of the bladder neck, represented by the difference in the $\alpha$ and $\beta$ angles at rest and stress, in a sample of continent women and women with SUI, to determine whether there is a significant difference in the angles of rotation ($R\alpha$ and $R\beta$) between the groups.

## Patients, subjects and methods

This was a prospective study to assess the numerical differences in rotation angles of the urethra between patients with SUI and a control group of continent women conducted from March 2013 to March 2014. An informed consent was obtained from all participants. The study was approved by the Higher Committee for the Standards and Ethics of Scientific Research in the College of Medicine.

The study enrolled 30 women with SUI (confirmed by urodynamic tests) and 30 women with no history of UI (control group). All the participants had negative urine cultures before TPUS. The women with SUI were recruited from the urodynamic unit, and the urology and gynaecology departments. The continent women were selected from medical staff and patients' family members after denying any history of urinary tract symptoms or UI. A complete gynaecological examination was performed for all participants and those with significant descent of at least the lower third of the vagina with straining were excluded. In addition, pregnant women or those within 6 weeks postpartum, women with neurological diseases such as spinal cord injury, history of trauma, medications that could cause UI, pelvic tumours, those with previous pelvic surgery (including caesarean section), and those who had already undergone corrective surgery for UI, were also excluded from the study.

### *US examination*

TPUS was performed using a Voluson 730 Pro US machine (GE Medical Systems, Austria) mounted with a 3.5 MHz electronic microconvex array probe. No specific preparation was required, apart from partially filling the urinary bladder to ≈150 mL, as estimated by transabdominal US. The TPUS was performed in the lithotomy position. The 3.5 MHz probe, covered with a sterile glove, was placed on the interlabial region of the vulva in a sagittal orientation after gel application using the lower edge of the symphysis pubis as a reference point to obtain views of the symphysis pubis, bladder, and urethra. Image orientation and screen display were standardised, so that the transducer appears at the top, the left side is the ventral aspect of the patient and the upper is the caudal aspect. When the inferior edge of the symphysis pubis, the bladder, urethrovesical junction, and the urethra were visualised during rest, the image was frozen and placed on one side of the screen. The participant was asked to strain (Valsalva manoeuver) and again the image was frozen, and placed on the other half of the screen.

US measurements included: the angle between the axis of the proximal urethra and the central axis of the symphysis pubis (α angle, Fig. 1) and the angle between the proximal urethra and the posterior vesical wall (β angle, Fig. 2). These measurements were recorded both at rest and at maximum straining (Valsalva manoeuver). To keep intra-observer variability to a minimum, all the US scans were performed by the same radiologist who was unaware of the continence status of the subject, three measurements were taken for each variable and the mean value calculated. The differences in the α and β angles in both groups, at rest and straining, were considered as the rotation angles (Rα and Rβ).

Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS) version 20. Independent samples *t*-tests were used to determine differences between the two groups. Receiver operating characteristic (ROC) curves, sensitivities and specificities were used to study the relation between parameters. A $P \leqslant 0.05$ was considered to indicate statistical significance.

## Results

The study comprised 30 women with genuine SUI, as confirmed by urodynamic studies, with a mean (SD, range) age of 37.53 (12.54, 27–60) years and 30 continent women with a mean (SD, range) age of 35.27 (10.19, 20–62) years. The age of the SUI group and the control group was matched with no significant difference.

The analysis of the result of TPUS revealed that at rest, the mean (SD) α angle of the SUI group was 64.37 (12.79)°, which was significantly higher than that of the control group at 43.90 (1.52)° ($P = 0.001$). Similarly, the α angle at straining (Valsalva manoeuvre) was also significantly higher in the SUI group vs the control group, at a mean (SD) of 83.80 (14.22) vs 54.43 (2.59)° ($P < 0.001$; Table 1).

The mean (SD) β angle in the SUI group at rest was 125.27 (18.73)°, which was significantly higher than that of the control group at 107.53 (19.81)° ($P = 0.001$). Similarly, at straining (Valsalva manoeuvre), the mean (SD) β angle was significantly higher in the SUI group vs the control group, at 153.57 (26.86) vs 123.87 (22.67)° ($P < 0.001$).

Calculating the numerical value of the increment of both the α and β angles in both groups, at rest and at straining, to which we refer to as the rotation angle α and rotation angle β (Rα and Rβ) revealed a statistically significant difference in the mean increment in the value of each angle (Table 1). Higher increment values, i.e. higher rotation angles, were reported in the SUI group for both the α angle and the β angle compared with those of the control group [mean (SD) Rα SUI 19.43 (12.76) vs controls 10.53 (2.98)°; and Rβ SUI 28.30 (12.96) vs controls 16.33 (10.8)°; $P < 0.001$].

The threshold values for the urethral angles were established using the ROC curve and are represented in Table 2. The threshold value of >46.5° for the α angle at rest had the highest sensitivity and specificity (96.7% and 100%, respectively), while at stress a thresh-

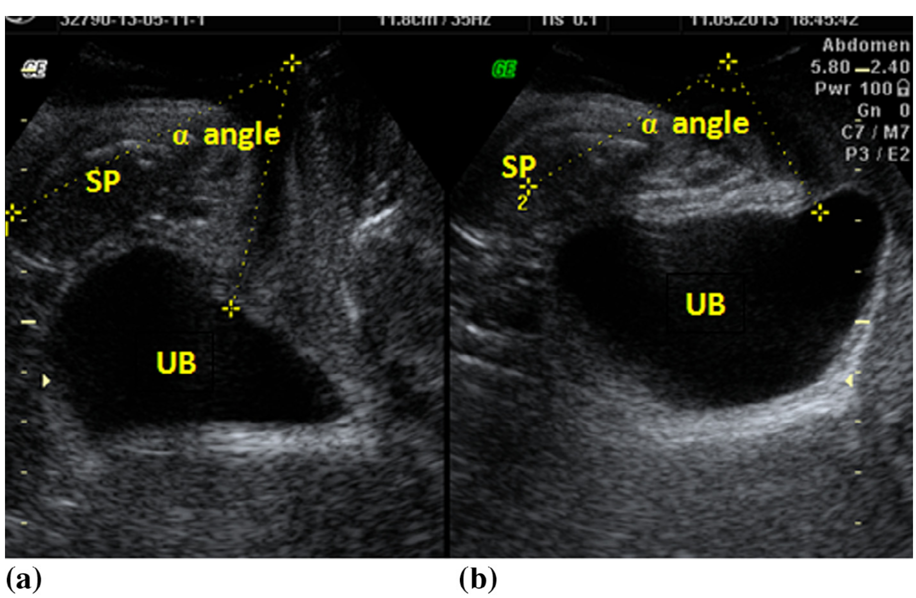
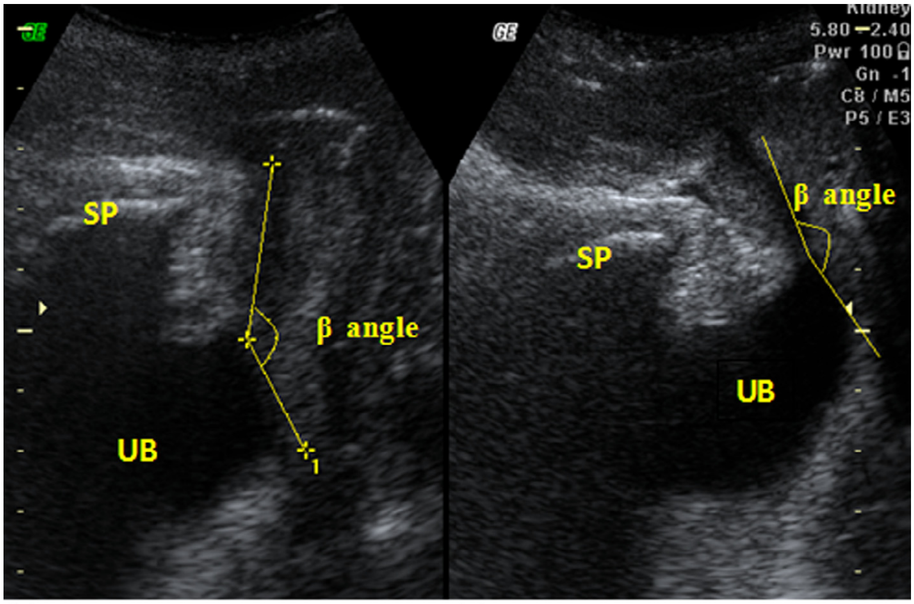



**Figure 1** TPUS for the assessment of α angle at rest (a) and straining (b). SP, symphysis pubis; UB, urinary bladder.




(a) (b)

**Figure 2** TPUS for the assessment of the β angle at rest (a) and straining (b). SP, symphysis pubis; UB, urinary bladder.

**Table 1** Urethral angles at rest and straining in the SUI and control groups and the rotation angles for both groups.

| Urethral angles, mean (SD) ° | Control group $N = 30$ | SUI group $N = 30$ | $P$ |
|---|---|---|---|
| α angle at rest | 43.90 (1.52) | 64.37 (12.79) | < 0.001 |
| α angle at straining (Valsalva manoeuvre) | 54.43 (2.59) | 83.80 (14.22) | < 0.001 |
| Rα, difference in α angle at rest and at straining (Valsalva manoeuvre) | 10.53 (2.98) | 19.43 (12.76) | < 0.001 |
| β angle at rest | 107.53 (19.81) | 125.27 (18.73) | 0.001 |
| β angle after Valsalva manoeuvre | 123.87 (22.67) | 153.57 (26.86) | < 0.001 |
| Rβ, difference in β angle at rest and at straining (Valsalva manoeuvre) | 16.33 (10.8) | 28.30 (12.96) | < 0.001 |

**Table 2** Threshold values of the urethral angles at rest and straining in the SUI and control groups (30 in each group) with their respective sensitivity and specificity.

| Urethral angle, ° | Control group | SUI group | Sensitivity, % | Specificity, % |
|---|---|---|---|---|
| *α angle at rest* | | | | |
| ⩽46.5 | 30 (true negative) | 1 (false negative) | 96.7 | 100 |
| > 46.5 | 0 (false positive) | 29 (true positive) | | |
| *α angle at straining (Valsalva manoeuvre)* | | | | |
| ⩽58.5 | 29 (true negative) | 1 (false negative) | 96.7 | 96.7 |
| > 58.5 | 1 (false positive) | 29 (true positive) | | |
| *β angle at rest* | | | | |
| ⩽119 | 23 (true negative) | 11 (false negative) | 63.3 | 60 |
| > 119 | 7 (false positive) | 19 (true positive) | | |
| *β angle at straining (Valsalva manoeuvre)* | | | | |
| ⩽141.5 | 24 (true negative) | 8 (false negative) | 73.3 | 80 |
| > 141.5 | 6 (false positive) | 22 (true positive) | | |

old value of > 58.5° has a sensitivity and specificity of 96.7%. For the β angle, the threshold values were > 119 and 141.5° at rest and at stress, respectively, with lower sensitivity and specificity (Table 2).

## Discussion

The use of TPUS for assessing urethral angles and dynamic pubo-urethral descent distance has been considered as an important investigational tool for objective documentation of anatomical and functional parameters of the pelvic floor before and after surgery [3,9]. Since the 1980s, TPUS has been used as an alternative to urethrocystography in patients with SUI and provides information similar to that obtained by urethrocystography without exposure to radiation [10].

The US assessment of the dynamic bladder neck position, the angle of inclination (α angle) and posterior urethrovesical angle (β angle) in normal subjects and in patients with UI has been investigated by several researchers [4,5,10–15]. Although, all these studies agree in some way or another that urethral angles are different between the normal individual and patients with UI, and that they undergo dynamic changes upon straining (Valsalva manoeuvre), the numerical values obtained are variable and no clear definition of 'normal' or 'abnormal' values has been set. These variations can be attributed to the variation in the methodology of the US examination (perineal, transvaginal or interiotal) and the protocol of urinary bladder filling in each study.

In the present study, the α angle was significantly higher in the SUI group at both rest and straining (Valsalva manoeuvre) [mean (SD) 64.37 (12.79) and 83.80 (14.22)°, respectively] compared with that in the control group [mean (SD) 43.90 (1.52) and 54.43 (2.59)°, respectively]. These results are in agreement with those of Yang and Huang [16], who retrospectively reviewed transvaginal US records for 764 patients with SUI and 36 normal subjects and found significantly higher resting and straining angles in the SUI group as compared with those of the controls [mean (SD) 97 (23) and 152 (34)° vs 81 (15) and 113 (27)°]. In a national study conducted by Akram [17] on 20 patients with SUI, introital US showed a significantly higher resting α angle in the SUI group as compared with that in the continent subjects [mean (SD) 100.6 (3.6) vs 92.1 (3.6)°], the α angle values in that study are similar to results obtained by Minardi et al. [14] who also conducted introital US on 36 patients with SUI and correlated the results with 14 healthy individuals [mean (SD) 118.2 (24.3) vs 102.7 (11.0)°]. The resting α angle values in these studies are higher than those obtained in our present study, taking into consideration that all these studies used different routes of US examination (transvaginal and introital US), the distortion of the anatomy of the urethra caused by the pressure of the closely applied transducer, in addition to the fact that the transvaginal and introital US transducers are less supported than the transducer applied to the perineum allowing more mobility of the probe during the examination, thus adding more to the distortion of the anatomy, which may be responsible for the higher numerical values of the α angle. On the other hand, Antovska [11] in a study conducted on 132 patients with SUI, reported mean (SD) α angle values of 67.2 (4.5) and 66.9 (3.3)° at rest and stress, respectively, with no statistical significance between them. Once again, the variation in the methodology of the US examination could be a major but not sole factor, as in the aforementioned study the author preferred to empty the urinary bladder of the patients completely by catheterisation immediately before the TPUS.

The posterior urethrovesical angle (also referred to as the retrovesical angle or β angle) is another parameter that was assessed by TPUS. This angle has been related to the functional integrity of both the proximal urethral supports; Pregazzi et al. [5] suggested a significant role of the β angle in maintaining female continence; Sendag et al. [4] in a study conducted on 17 normal volunteers and 30 patients with SUI found that the β angle was significantly higher in the SUI group, at rest and stress, as compared with that in the healthy control group, and they concluded that a β angle of > 120° correlates with poor support to the urethrovesical junction. Several other authors agree with this conclusion but with variable numerical values of the β angle [10,12]. The results of the present study are in agreement with the previously mentioned studies, as we found significant differences in the β angle between the control and SUI groups, at rest and straining (Valsalva manoeuvre). However, this is in disagreement with the results of Alper et al. [18], who did not find a statistical significance between the control and SUI groups at rest but only when performing the Valsalva manoeuvre. Although most of the above mentioned studies agree that there is a significant variation in the urethral angles between normal subjects and patients with SUI, only a few have proposed a threshold value. In the present study, the threshold value for the β angle at stress was > 141.5° and this was found to have a sensitivity and specificity of 73% and 80%, respectively. A similar threshold value was suggested by Al-Khuzaee and Al-Saadi [12], while Gungor et al. [19] suggested a lower threshold value of > 120°. On the other hand, Yang and Huang [16] stated that it is not possible to select a threshold value for cystourethrographic parameters due to the wide range of overlap. In the present study, the threshold value for the α angle at stress was > 58.5°, with a high sensitivity and specificity of ≈97%. To the best of our knowledge, no other studies have suggested a threshold value for this angle. We think that the α angle provides a fairly sensitive insight into the integrity of both the proximal and distal urethral supports in patients with SUI.

In the present study, the mean difference between each angle in each group at resting and straining was calculated to determine whether there was any variation between the groups. This difference was regarded as the rotation angle (Rα, Rβ). The mean difference between the straining and resting values of the α and β angles in the SUI group were about twice those of the corresponding values in the control group [mean (SD) Rα angle 19.43 (12.76) and 10.53 (2.98)°, Rβ angle 28.30 (12.96) and 16.33 (10.8)°], which was statistically different. To our knowledge there is no other study that has dealt with the calculation of the mean difference. We think that the estimation of the rotation angle may overcome the wide variability range in the proposed urethral angles values estimated by different US techniques.

The present study have some limitations, among these is the relatively limited sample size that prohibited classifying subjects into several groups that incorporate certain variables, such as body mass index, parity, and mode of delivery, as these variables may further refine the threshold value of the urethral rotation angles. Further studies on the significance of the threshold values of the dynamic rotation angles with different methodologies in different age groups and parity are required to validate the present results.

In conclusion, urethral rotation angles are new US parameters that may assist in the assessment and diagnosis of patients with SUI, which may in turn reduce the need for sophisticated urodynamic studies.

## Conflict of interest

Nothing to declare.

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None.

## References


[1] Melville JL, Katon W, Delaney K, Newton K. Urinary incontinence in US women: a population-based study. *Arch Intern Med* 2005;**165**:537–42.

[2] Blaivas JG. Outcome measures for urinary incontinence. *Urology* 1998;**51**(Suppl. 2A):11–4.

[3] Torella M, De Franciscis P, Russo C, Gallo P, Grimaldi A, Ambrosio D, et al. Stress urinary incontinence: usefulness of perineal ultrasound. *Radiol Med* 2014;**119**:189–94.

[4] Sendag F, Vidinli H, Kazandi M, Itil IM, Askar N, Vidinli B, et al. Role of perineal sonography in the evaluation of patients with stress urinary incontinence. *Aust N Z J Obstet Gynaecol* 2003;**43**:54–7.

[5] Pregazzi R, Sartore A, Bortoli P, Grimaldi E, Troiano L, Guaschino S. Perineal ultrasound evaluation of urethral angle and bladder neck mobility in women with stress urinary incontinence. *BJOG* 2002;**109**:821–7.

[6] Schaer GN, Koechli OR, Schuessler B, Haller U. Perineal ultrasound for evaluating the bladder neck in urinary stress incontinence. *Obstet Gynecol* 1995;**85**:220–4.

[7] Schaer GN, Koechli OR, Schuessler B, Haller U. Perineal ultrasound: determination of reliable examination procedures. *Ultrasound Obstet Gynecol* 1996;**7**:347–52.

[8] Dietz HP. Ultrasound imaging of the pelvic floor. *Ultrasound J Obstet Gynecol* 2004;**23**:80–92.

[9] Howden NS, Zyczynski HM, Moalli PA, Sagan ER, Meyn LA, Weber AM. Comparison of autologous rectus fascia and cadaveric fascia in pubovaginal sling continence outcomes. *Am J Obstet Gynecol* 2006;**194**:1444–9.

[10] Kolbl H, Berknaschek G, Wolf GA. Comparative study of ultrasound scanning and urethrocystography in patients with genuine stress incontinence. *Arch Gynecol Obstet* 1988;**244**:39–45.

[11] Antovska VS. Ultrasound characteristics of patients with urinary stress incontinence with or without genital prolapse. *Korean J Urol* 2012;**3**:691–8.

[12] Al-Khuzaee LR, Al-Saadi WI. Perineal ultrasound for evaluating bladder neck and urethra in stress urinary incontinence. *Iraqi J Med Sci* 2012;**10**:367–74.

[13] Onofriescu M, Nemescu D. Evaluation of patients with stress urinary incontinence by perineal ultrasound. *Ultrasound Obstet Gynecol* 2005;**26**:460 (abstract P14.01).

[14] Minardi D, Piloni V, Amadi A, El Asmar Z, Milanese G, Muzzonigro G. Correlation between urodynamics and perineal ultrasound in female patients with urinary incontinence. *Neurourol Urodyn* 2007;**26**:176–82.

[15] Di Pietto L, Scaffa C, Torella M, Lambiase A, Cobellis L, Colacurci N. Perineal ultrasound in the study of urethral mobility: proposal of a normal physiological range. *Int Urogynecol J* 2008;**19**:1405–9.

[16] Yang JM, Huang WC. Discrimination of bladder disorders in female lower urinary tract symptoms on ultrasound cystourethrography. *J Ultrasound Med* 2002;**21**:1249–55.

[17] Akram W. Correlation between genuine stress incontinence in women and bladder neck mobility as assessed by inter labial ultrasound scan. *Iraqi J Comm Med* 2010;**3**:169–72.

[18] Alper T, Cetinkaya M, Okutgen S, Kökçü A, Malatyalioğlu E. Evaluation of urethrovesical angle by ultrasound in women with and without urinary stress incontinence. *Int Urogynecol J Pelvic Floor Dysfunct* 2001;**12**:308–11.

[19] Gungor M, Salih M, Cengiz B. Transvaginal sonography in the evaluation of urinary stress incontinence. *Gynecol Obstet Reprod Biol Med* 1997;**3**:436–8.