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Evaluation of changes in urethral rotation angle and quality of life after stress urinary incontinence surgery with transperineal ultrasonography

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Abstract

The aim of this study was to evaluate the change in preoperative and postoperative urethral rotation angle by transperineal ultrasonography (TPUS) and its reflection on clinical outcomes in patients undergoing transvaginal tape (TVT) surgery for stress urinary incontinence (SUI). This retrospective study included 40 patients who underwent TVT surgery. TPUS and urethral rotation angle (URA) values, International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF) scores and quality of life scores were recorded preoperatively and 6 months postoperatively. The data were analyzed using descriptive statistical methods. The mean age of the patients was 50.7±7.9 years. Furthermore, 57.5% of the patients in the study (n=23) were postmenopausal. In the preoperative period, 90% of participants (n=36) reported severe limitations in their quality of life, as measured by the ICIQ-SF. URA decreased from 57.7±5.1° preoperatively to 31±8.7° postoperatively (p=0.001). ICIQ-SF score decreased from 17.9±2.7 to 2.4±3.5 and quality of life score decreased from 9.1±1.5 to 0.5±1 (p=0.001). Both anatomical and functional improvement was found after TVT surgery. TPUS is a useful method for noninvasive and objective monitoring of surgical efficacy in the treatment of SUI.

Keywords: Stress urinary incontinence, transvaginal tape surgery, urethral rotation angle, transperineal ultrasonography, quality of life

1. Introduction

Urinary incontinence (UI), which increases in frequency with age, is defined as involuntary urinary leakage. The prevalence varies depending on the population studied, the measurement period, the tools used to assess severity and definitions (1,2). The general prevalence of urinary incontinence in non-pregnant women aged 20 years and older varies between 10% and 60%. It is a social and hygienic problem. It becomes more important with increasing life expectancy (3-7).

Stress urinary incontinence (SUI), which is the most common type of incontinence especially in young women, is involuntary urinary incontinence caused by increased intra-abdominal pressure (e.g. exertion, sneezing, coughing, laughing) without bladder contraction (8, 9, 10). It is caused by urethral hypermobility or intrinsic sphincter failure. Inadequate support of the pelvic floor muscles and vaginal connective tissue to the urethra and bladder neck is thought to cause urethral hypermobility (11). Loss of intrinsic urethral mucosal and muscle tone, which normally keeps the urethra closed, is a form of SUI resulting from intrinsic sphincter insufficiency, and there is a lack of standardization in definition and diagnostic criteria (12).

In addition to traditional diagnostic methods including history and physical examination, UI questionnaires, urinalysis and Q-type tests, medical diagnostic methods also have certain limitations. Therefore, evaluation of loss of urethral function and morphologic changes is crucial for the correct diagnosis of SUI. Transperineal ultrasonography (TPUS), which is universally accepted to evaluate SUI, is a non-invasive test that shows anatomical structures, but its commonly used parameters contain limited information and may be insufficient (13). This is because SUI results from a complex interaction of pelvic floor muscles, nerves, hormones and other factors. Studies have shown that urethral motility indices may vary depending on conditions and measurement methods. [14,15). Objective and visual methods for assessing the effect of bladder neck hypermobility, which is very important in SUI, are lacking and results differ between studies (16).

In this study, we aimed to evaluate the change in preoperative and postoperative urethral rotation angle by TPUS and its reflection on clinical outcomes in patients who underwent transvaginal tape (TVT) surgery for stress urinary incontinence.

2. Material and Methods

This retrospective observational study was conducted between January 2022 and January 2025 at Giresun Gynecology and Pediatrics Training and Research Hospital. The study included 40 patients who underwent TVT operation for SUI. Our study has been approved by the Scientific Research Ethics Committee of Giresun Education and Research Hospital with protocol number 14.05.2025/20.

Medical history, menopausal status, gynecologic and pelvic surgery history, age, height, weight and pregnancy data were obtained from medical records. Physical examination findings,

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3-day bladder diary, International Bladder Consultation Incontinence Questionnaire Short Form (ICIQ-SF) evaluation, routine blood biochemistry and complete urinalysis results were obtained from computer records. All patients underwent 2D TPUS preoperatively and at 6 months postoperatively in the lithotomy position at rest and during the valsalva maneuver. Transperineal ultrasound (TPUS) was conducted using equipment from Philips Healthcare. A multifrequency 6 MHz convex-array vaginal probe was utilized for the examination. Once the estimated post-void residual urine volume reached approximately 150 mL, the transducer was positioned on the perineum in the sagittal plane to perform the assessment. Bladder volume was calculated using the formula: 5.9 × (bladder height × bladder depth in the sagittal plane) − 14.6 mL (17).

Those with stage 2 or higher pelvic organ prolapse, previous pelvic surgery, pelvic radiotherapy, neuropsychiatric disorders, diabetes mellitus, genitourinary tumors, urinary tract infection and suspected fistula were excluded. Cystocele was considered as a 10 mm descent of the bladder from the pubic bone taken as a reference with valsalva. Patients who presented with urinary incontinence caused by physical activity such as coughing, sneezing or laughing and had a positive cough stress test (CST: Observation of urinary incontinence with coughing) were included in the study.

Women diagnosed with SUI were evaluated by the same gynecologist by determining the maximum valsalva maneuver from resting in the dorsal lithotomy position and at least 3 valsalva maneuvers. On ultrasound, pubic symphysis, urethra, bladder, vagina and rectum were observed in the midsagittal plane. The degree of urethral rotation was calculated by measuring the change in angle between the proximal urethra and a horizontal reference line from rest to Valsalva effort (18).

The ICIQ-SF questionnaire is composed of four questions. The questionnaire comprises three scored questions and an additional question that permits multiple selections. This additional question is not included in the scoring, but it aims to identify factors that trigger incontinence. Participants can score a minimum of 0 points and a maximum of 21 points on this questionnaire. The third question of the questionnaire specifically addresses the impact of incontinence on the quality of life of the individual, utilising a scale from 0 to 10, with higher scores indicating greater impact on the individual's life (9).

During the TVT operation, the patient is positioned in the lithotomy position and is typically administered either spinal or general anaesthesia. Prior to the initiation of the procedure, a Foley catheter is inserted in order to empty the bladder. A longitudinal incision of approximately 1.5–2 cm is made in the vaginal region, situated just below the midline of the urethra. The creation of blind paravaginal tunnels is evident on both sides, extending towards the retropubic area up to the obturator membrane. The specially angled needles of the TVT implant are inserted through these tunnels and subsequently exited through incisions in the skin of the groin area. Subsequently, a synthetic polypropylene tape is inserted through the vaginal tunnel and positioned beneath the urethra. The tape is applied using a "tension-free" technique, and the bladder's fullness is assessed to ensure the absence of urethral obstruction. At the conclusion of the procedure, the vaginal and skin incisions (11).

2.1. Statistical analyses

Statistical evaluation was performed using SPSS 21 for Windows (SPSS, Chicago, IL, USA). The normality of data distribution was assessed using both a parametric test (Shapiro-Wilk test) and a visual method (histograms). Data are presented as mean ± standard deviation and median (minimum and maximum values). In our study, perineal ultrasonography findings were analyzed by applying the paired t-test for data with normal distribution, and the Wilcoxon signed-rank test for data that did not meet normality assumptions. A p-value less than 0.05 was considered to indicate statistical significance.

3. Results

The mean age of the 40 patients included in the study was 50.7±7.9 years. The median number of pregnancies was 3 (1-4), parity 2 (0-3) and abortions 1 (0-2). The mean body mass index (BMI) of the participants was 27.4±3 kg/m². 57.5% of the participants were in menopause. In terms of mode of delivery, 40% had a cesarean section. In the preoperative period, 90% of the patients had “severe” quality of life impairment as assessed by ICIQ-SF and 10% had “moderate” quality of life impairment. In the postoperative period, 80% had a “mild” effect and 20% had a “moderate” effect (Table 1).

Table 1. Clinical and demographic data

Variables	Mean ± Standard Deviation	Median (min - max)
Age	50.7±7.9	
Gravida	-	3 (1-4)
Parity	-	2 (0-3)
Abortion	-	1 (0-2)
Height, m	1.60±0.03	-
Weight, kg	70±7.5	-
Body Mass Index, kg/m²	27.4±3	-
Postmenopause (n, %)		
Yes	23 (57.5)	
No	17 (42.5)	
Cesarean section birth story (n, %)	16 (40)	
Preoperative ICIQ-SF impact on quality of life (n, %)		
Middle	4 (10)	
Severe	36 (90)	
Postoperative ICIQ-SF impact on quality of life (n, %)		
Middle	32 (80)	
Severe	8 (20)	

ICIQ-SF: International Consultation on Incontinence Questionnaire Short Form

The mean urethral rotation angle (URA) measured by transperineal ultrasonography was 57.7 ± 5.1° preoperatively and decreased significantly to 31 ± 8.7° postoperatively (mean difference: 26.6 ± 10°; 95% CI: 23.4 - 29.8; p=0.001). ICIQ-

SF total score decreased from 17.9 ± 2.7 preoperatively to 2.4 ± 3.5 postoperatively. This change was statistically significant (mean difference: 15.5 ± 5.3; 95% CI: 13.7 - 17.2; p=0.001). Similarly, significant improvement was observed in quality of life scores. The quality of life impact score decreased significantly from 9.1 ± 1.5 preoperatively to 0.5 ± 1 postoperatively (mean difference: 8.6 ± 2.4; 95% CI: 7.8 - 9.3; p=0.001), the data are given in table 2. Preoperative and postoperative changes in measurements and the differences (Δ values) between these changes are also presented visually in Fig. 1 and 2.

Table 2. Preoperative and postoperative URA and changes in quality of life

Variables	Preoperative (n:40) Mean ± SD	Postoperative (n:40) Mean ± SD	P value	Δ value Mean ± SD (95 %CI Lower-Upper)
URA (Min - Max)	57.7 ± 5.1 (50 - 70)	31 ± 8.7 (18 - 43)	**0.001**	26.6 ± 10 (23.4 - 29.8)
ICIQ-SF	17.9 ± 2.7 (14 – 21)	2.4 ± 3.5 (2 – 7)	**0.001**	15.5 ± 5.3 (13.7 - 17.2)
Postoperative ICIQ-SF impact on quality of life	9.1 ± 1.5 (6 – 10)	0.5 ± 1 (0 – 4)	**0.001**	8.6 ± 2.4 (7.8 - 9.3)

SD: Standart Deviation, Δ value: difference between preoperative and postoperative measurements, ICIQ-SF: International Consultation on Incontinence Questionnaire Short Form, URA: Urethral Rotation Angle

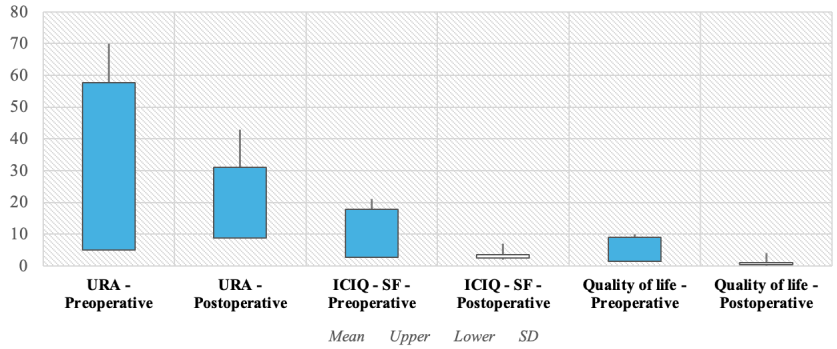

Fig. 1. Preoperative and postoperative changes of measurements

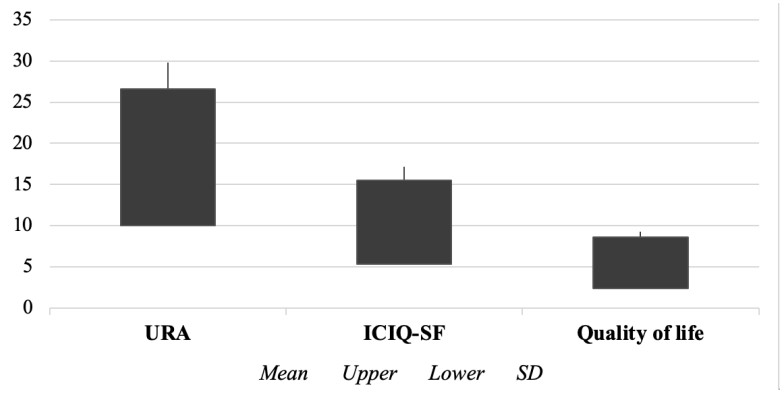

Fig. 2. Δ values of measurements: difference between preoperative and postoperative measurements

4. Discussion

Pelvic floor ultrasonography is frequently used in pelvic floor disorders because it is easily applicable, low-cost and accessible. TPUS can define anatomical changes in the lower genitourinary structures, bladder neck and urethral mobility during valsalva maneuver (19-22). We observed a significant decrease in URA in patients who underwent TVT surgery for stress urinary incontinence. To the best of our knowledge, this is one of the few studies evaluating the change in URA before and after TVT.

Stress urinary incontinence is a multifactorial disorder that can be easily diagnosed by CST; it is affected by intrinsic anatomical features such as loss of integrity of the bladder neck, bladder base and vaginal musculofascial connections that hold the proximal urethra in the retropubic position (22-24). At rest, the bladder neck of patients with SUI is in a more posterior and caudal position than in continent women. Moreover, urethral behavior during straining causes the bladder neck to move to an even more posterior and caudal position. A more posterior and caudal displacement of the urethra bladder neck under stress is seen in both continent and incontinent women, but a greater displacement is seen in incontinent women, resulting in failure of continence mechanisms (25). In the literature, there are studies showing that changes in bladder neck position are different in continent and incontinent women (25- 28). In a recently published study including 36 patients who underwent TVT operation due to mixed urinary incontinence, URA was found to be significantly lower

compared to the preoperative period when evaluated with TPUS at the 2nd year postoperative controls, the mean ICIQ-SF questionnaire score was reported as 5.28 postoperatively from 16.39 preoperatively in the same study, and it was statistically shown that the effects of urinary incontinence on general quality of life decreased after TVT (29). In our study, URA was 31±8.7 (18-43) at the 6th month postoperative follow-up, 26.6±10 degrees lower than the preoperative values and this was statistically significant. Similarly, the mean ICIQ-SF questionnaire score decreased from 17.9 preoperatively to 2.4 postoperatively and positive effects on quality of life were observed (p:0.001). These results are consistent with the literature. Suburethral sling/band implant provides an effective surgical treatment.

The strengths of the study are that TPUS was performed by a single center and by the same person, which reduced the possibility of measurement bias in practice. URA measured by transperineal ultrasonography is valuable in terms of objectively demonstrating the anatomical effectiveness of surgery. Evaluation of both preoperative and postoperative periods is important to show the cause-effect relationship of the change. The statistically significant improvement in quality of life obtained with the ICIQ-SF questionnaire increases the clinical value of the study. The validity and reliability of your study increases as your findings are in line with previous studies. The identification of changes in the URA contributes to the understanding of the anatomical origins of stress urinary incontinence.

The limitations of the study are that it was a retrospective observational study and urethral sphincter function was not measured by urodynamic testing. Retrovesical angle and bladder neck collapse were not evaluated by TPUS. Sample size is relatively small. The lack of a comparison group of continent women makes it difficult to assess the specificity of change. The effect on psychosocial or sexual function was not evaluated. A postoperative follow-up of only 6 months may not provide sufficient information on the long-term persistence of surgical efficacy.

In conclusion, this study demonstrated that there was a significant reduction in URA in the postoperative period and that this anatomical improvement had a positive impact on quality of life. The significant reduction in ICIQ-SF scores also supports the symptomatic benefit of surgery. These results suggest that TVT surgery provides successful outcomes at both the anatomical and functional levels and that TPUS can be a reliable assessment method in this process. However, considering the limitations of the study such as limited number of patients, prospective studies with larger samples and longer follow-up periods are needed.

Conflict of interest

The authors declared no conflict of interest.

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None to declare.

Authors' contributions

Concept: S.B.Y., K.İ.A.Y., Design: S.B.Y., K.İ.A.Y., Data Collection or Processing: S.B.Y., K.İ.A.Y., Analysis or Interpretation: S.B.Y., K.İ.A.Y., Literature Search: S.B.Y., K.İ.A.Y., Writing: S.B.Y., K.İ.A.Y.,

Ethical Statement

Our study has been approved by the Scientific Research Ethics Committee of Giresun Education and Research Hospital with protocol number 14.05.2025/20.

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