International Journal of Women's Health Dovepress

Open Access Full Text Article ORIGINAL RESEARCH

# Comparative Analysis of the Efficacy of Different Surgical Modalities for the Treatment of Female Stress Urinary Incontinence: A Multicenter Retrospective Study

Zhuo Jiang[1], Chaoyan Yuan[2]

[1]Department of Medical School, Hubei Minzu University, Enshi, Enshi Tujia and Miao Autonomous Prefecture, Hubei, People's Republic of China; [2]Department of Gynecology, Minda Hospital of Hubei Minzu University, Enshi, Enshi Tujia and Miao Autonomous Prefecture, Hubei, People's Republic of China

Correspondence: Chaoyan Yuan, Email 2569537144@qq.com

**Objective:** To compare the efficacy of autologous fascial retropubic midurethral sling, anterior vaginal wall epithelial flap midurethral suspension, tension-free vaginal tape-obturator and adjustable urethral suspension with a single incision for the treatment of female stress urinary incontinence.

**Materials and Methods:** A total of 243 SUI patients who were admitted to Minda Hospital of Hubei Minzu University, were chosen and split into four groups based on various surgical techniques: the AFS group (59 cases), TVT-O group (61 cases), epithelial flap group (62 cases) and ASIS group (61 cases). A comparison of four patient groups' quality-of-life scores, urodynamic indices, urethral structure-related indices before and a year after treatment, complication rates and perioperative-related indices.

**Results:** There was no discernible difference in the treatment outcomes among the four groups($P>0.05$). However, the ASIS group exhibited significantly reduced intraoperative hemorrhage, hospitalization duration and operative time compared to the mucosal flap and TVT-O groups($P<0.05$). Both the TVT-O and ASIS groups demonstrated significantly higher hospitalization expenditures than the mucosal flap and AFS groups ($P<0.05$). No significant differences were observed in postoperative indwelling catheterization, IIQ-7 and I-QOL ratings, urodynamic indices or urethral structure-related indexes across the four patient groups($P>0.05$). The TVT-O group showed a significantly higher incidence of postoperative medial thigh pain compared to the AFS, mucosal flap, and ASIS groups ($P<0.05$). Similarly, the AFS group had a significantly greater incidence of postoperative urine retention compared to the mucosal flap, TVT-O, and ASIS groups($P<0.05$).

**Conclusion:** While all four surgical techniques demonstrated good efficacy and improved patients' quality of life, our study suggests that TVT-O had a significantly higher incidence of post-treatment medial thigh pain and ASIS may be a safer and less problematic surgical approach for the treatment of female SUI. This has important therapeutic implications.

**Keywords:** mid-urethral slings, stress urinary incontinence, tension-free vaginal tape, Urethral Slings

## Introduction

Complaint of involuntary loss of urine on effort or physical exertion, such as when sneezing or coughing, is known as stress urinary incontinence(SUI). Based on survey,[1] the global prevalence of urine incontinence in women is up to 38%. Individuals suffering from SUI have depressive, anxious or insomniac feelings, which can significantly lower their standard of living. The mechanism of SUI may be due to downward displacement of the bladder neck and proximal urethra, decreased closure of the urethral mucosa, or decreased function of the intrinsic urethral sphincter. The main treatment options for SUI encompass both conservative and surgical approaches. Conservative treatments include pelvic floor muscle exercise, pelvic floor magnetic wave stimulation therapy and intravaginal laser therapy. Surgery is recommended when the patient has severe SUI or when there is no change in symptoms after 3 months of conservative

Received: 31 August 2024
Accepted: 15 November 2024
Published: 29 November 2024

treatments. There are several surgical options for treating SUI. Multiple studies have demonstrated[2] that tension-free vaginal tape-obturator (TVT-O) is a procedure with definitive efficacy. However, concerns over complications associated with mesh implantation, such as infections, inner thigh discomfort, and pain during sexual activity, have fueled growing interest in researching alternatives. Autologous fascial midurethral sling (AFS) can prevent the the risks associated with mesh implantation.[3] However, this procedure has drawbacks including long operating times, high operator requirements, and increased intraoperative bleeding that limit its widespread application. The urethral suspension in anterior vaginal wall epithelial flap is more common for the treatment of anterior pelvic prolapse.[4] In recent years, research[5,6] has demonstrated the effectiveness of urethral suspension in anterior vaginal wall epithelial flap for the treatment of SUI. However, the long-term efficacy of this procedure is currently unclear. The usage of single-incision sling (ASIS) in the clinic has increased with technological advancements. In this study, we compared the therapeutic effects of AFS, epithelial flap midurethral suspension on the anterior vaginal wall, TVT-O and ASIS for the treatment of SUI in a cohort of 243 patients. This provided guidance for the development of the clinical treatment plan for SUI.

# Materials and Methods

## Methods

A total of 243 SUI patients who were hospitalized to the Department of Gynecology at Minda Hospital of Hubei Minzu University between January 2020 and January 2023 were chosen for the research. They were divided into 4 groups according to the surgical interventions they received: 59 cases in the AFS group, 61 cases in the TVT-O group, 62 cases in the epithelial flap group and 61 cases in the ASIS group. This study compared perioperative-related indicators and complication rates at a year post-surgery in four groups of patients. The quality of life scores, urodynamic parameters, and urethral structure-related parameters were measured on the day of admission and a year post-surgery. The TVT-O and ASIS procedures are mainly indicated for patients with urethral hyperactive SUI (MUCP>20cm$H_2O$) and mixed incontinence with predominantly SUI. The vaginal mucosal flap midurethral suspension and AFS procedures are mainly indicated for patients with comorbid diabetes mellitus. They reduce the incidence of postoperative mesh rejection and facilitate healing of the surgical wound. Patients with combined anterior vaginal wall prolapse are better candidates for midurethral suspension with an anterior vaginal wall mucosal flap. Subject to the above indications, the patient can choose the procedure according to her financial condition and wishes. The Institutional Ethics Board of Minda Hospital of Hubei Minzu University (Enshi, China) approved this study (Y2024024). As the type of study in this trial is a retrospective analysis of the original data, the above Ethics Committee has approved the waiver of patient consent.

## Inclusion/Exclusion Criteria

Inclusion criteria: ① Compliance with the diagnostic requirements delineated in the Guidelines for the Diagnosis and Treatment of Female Stress Urinary Incontinence, which are endorsed by the Gynaecological Pelvic Floor Group of the Obstetrics and Gynaecology Section of the Chinese Medical Association[7]; ② Pelvic floor muscle exercise does not work after 3 months; ③ 1-hour Urine Pad Test results suggesting leakage of more than 10g but 50g.

Exclusion criteria: ① Individuals diagnosed with incontinence resulting from induced urinary muscle dysfunction; ② Radiation therapy, urologic abnormalities, pelvic malignancy and severe pelvic organ prolapse (POP-Q staging≥grade 2) are the causes of SUI; ③ Except for mixed urinary incontinence (MUI) and urge urinary incontinence (UUI); ④ Individuals who have anti-incontinence surgery previously; ⑤ With severe coagulation issues.

## Surgical Methods

AFS group: A 3–4 cm transverse incision is made through the vaginal mucosa at 1 cm proximal to the urethral meatus in the anterior vaginal wall. Two stay sutures are then placed through the lower edge of the wound. The dissection is continued proximally past the midurethral point. The pelvic fascia is pierced on each side of the urethra to facilitate later passage of the McGuire needle. A rectangular strip sized approximately 1.5×7.5 $cm^2$ is harvested from the rectus sheath. A McGuire Suture Guide is passed through the rectus sheath at a point 1–2 cm lateral to the midline and is guided into the vaginal incision onto the index finger of the other hand. The ends of 0-PDS suture at one end of the fascial sling are

then passed through the eye and pulled through the vaginal incision into the abdominal wound. This procedure is repeated on the contralateral side. The graft is fixed in the midurethral position and the vaginal epithelium is then closed.

TVT-O group: The TVT-O exit was defined as the point where the horizontal line intersects 2 cm above the external urethral orifice and 2 cm lateral to the intersection of the femoral crease. The vaginal wall was divided from the bladder and urethra to the pubic symphysis and sub-pubic branches. Put the winged guide into the pathway, then insert the pusher along the pathway and through the occlusive membrane. After removing the guide, push the pusher's handle in the direction of the midline and rotate it until the tip exits the fixation point. Finally, remove the pusher, remove the sling and repeat the procedure for the contralateral puncture. After placing the sling and adjusting its tightness, the sling was secured with sutures in the mid-urethral fascia.

Epithelial flap group: The vaginal wall was cut at the transverse vaginal sulcus and inferior urethral sulcus and saline solution was injected into the vesicovaginal and urethrovaginal spaces. After removing a 3×2.5 $cm^2$ vaginal epithelial flap, the vaginal epithelial glands were destroyed by electrocauterizing the superficial tissue of the residual epithelial flap. The paraurethral space was divided from the cut edges to the lower edge of the descending pubic ramus and saline was injected into the urethrovaginal space from the lateral urethrovaginal margins of the left and right cut edges of the vaginal wall. The prolapsed urethra was supported by tying up the knot after the borders of the vaginal epithelial flap were sutured with silk suture to the fascia of the inferior border of the descending branch of the pubic bone.

ASIS group: A sagittal incision approximately 1.5 cm long was made 1 cm below the external urethral orifice. The subepithelial tissues on the lateral side of the urethra were separated to the inner and posterior edge of the pubic descending branch on both sides. After positioning the introducer front end horizontally into the right urethrovaginal space and positioning the tip of the anchor close to the posterior edge of the pubic bone's descending branch. When the handle of the introducer feels a breakthrough sensation after the tip of the anchor passes through the obturator membrane, slide up the lever to release the anchor and retract the flat piece of mesh tape below the urethra to secure the anchor in the obturator membrane. An adjustable anchor was positioned outside the occlusal membrane and the left occlusal area was perforated in the same manner as previously. Lay the sheet mesh belt flat beneath the mid-urethra, enter the probe to advance the sling lock and lock the anchor bolts, lock the sling's length, take out the probe, trim off any extra sling.

## Clinical Observation Indexes

① Perioperative variables: intraoperative blood loss volume, urinary catheterization, operation time, duration of hospitalization and hospitalization cost. ② Clinical outcomes: Using the Guidelines for the Diagnosis and Treatment of Female Stress Urinary Incontinence (2017)[7] as a guide, the patients' clinical results at a year following surgery were evaluated. The Cough stress test (CST) and 1-hour Urine Pad Test defined as evaluation criteria for this test. With the bladder filled with 300 mL of saline or subjective sensation of a full bladder, the bladder is often placed in the lithotomy position, and the leakage is observed by coughing forcefully several times in a row, which is represented by a positive CST. The 1-hour Urine Pad Test is a test in which the bladder is filled and lasts for 1 hour and the patient does not urinate from the start of the test. A weighed urine pad is pre-positioned. The patient drinks 500 mL of plain water within 15 minutes of the start of the test, after which the patient walks for the next 30 minutes, going up and down 1 flight of steps. For the last 15 minutes, the patient should sit and stand 10 times, cough 10 times, run in place for 1 minute, pick up objects on the ground 5 times and wash her hands with tap water for 1 minute. Lastly, the pads were weighed and the patient was asked to urinate and the urine output was measured. Cure criteria: negative CST and urine leakage less than 2g in the 1-hour Urine Pad Test; improvement criteria: positive CST and urine leakage no more than 2.5g in the 1-hour Urine Pad Test. The total effective rate can be calculated as follows: (number of improved cases + number of cured cases) / total cases x 100%. ③ Severity of incontinence and quality of life: More severe symptoms were indicated by higher scores on the International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICI-Q-SF), which was used to assess the degree of urine incontinence in patients both preoperatively and a year after surgery. The Incontinence Quality of Life Questionnaire (I-QOL) was utilized to evaluate the quality of life of the patients. The four aspects of urinary incontinence were evaluated using the Incontinence Impact Questionnaire Short Form (IIQ-7). Higher scores indicated a greater impact of urinary incontinence on the patient's quality of life. ④ Urodynamic indicators: A triple-lumen cystometric tube was uniformly retracted using a urodynamic analyzer to create urethral

pressure distribution curves. The patient's functional urethral length (FUL), maximum urethral closure pressure (MUCP) and Valsalva leak point pressure (VLPP) were measured both before surgery and a year after the procedure. Additionally, pressure-flow rate parameters such as maximum flow rate (MFR), average flow rate (AFR), voiding time (VT), voiding volume, detrusor pressure at the onset of urine flow (Pdet-Opening), and detrusor pressure at maximum flow rate (Pdet-Max Flow) were determined. ⑤ Lower urinary tract anatomy: Transperineal ultrasound was used to obtain ultrasound images of the patient's pelvic floor in the Valsalva state and at rest. Lower urinary tract anatomy included measuring bladder neck descent (BND), posterior urethral vesico-vaginal angle (PUVA) and urethral rotation angle (URA) both before surgery and a year after surgery. ⑥ Post-treatment complications: patients experienced post-treatment medial groin pain, urinary retention, dysuria, dyspareunia, urinary tract infection and bladder injury.

## Statistical Analysis

The current study utilized the statistical software SPSS 27.0 for data processing and analysis. For categorical count data, the chi-square test or rank sum test was employed to represent the data as percentages (n%). Meanwhile, continuous measures following a normal distribution were expressed asX±S, and comparisons between multiple groups were evaluated using one-way ANOVA. Paired-sample *t*-tests were conducted to compare results within groups. In addition, two-by-two comparisons were carried out using the LSD-*t* test or Tamhane's T2 technique. Measures consistent with a skewed distribution were denoted as M (P25, P75). The Kruskal–Wallis test was used for comparing multiple groups, while the Wilcoxon Signed Rank Test was applied for within-group comparisons. The significance level for all statistical tests was set at 5%.

# Results

## Baseline Characteristics

When the baseline characteristics from the four patient groups were analyzed, it was found that all of the differences were comparable and not statistically significant (P>0.05) (Table 1).

## Perioperative Variables

The ASIS group significantly outperformed other three groups for the three perioperative markers of intraoperative hemorrhage, operative time and hospitalization time (P<0.05), the TVT-O group was substantially smaller than the AFS group and epithelial flap group(P<0.05). Compared to the epithelial flap group, the AFS group experienced significantly longer surgery times and greater intraoperative bleeding (P<0.05). Hospitalization expenses were significantly greater in the TVT-O and ASISI groups compared to the epithelial flap and AFS groups (P<0.05). Between the four groups, there was no discernible variation in the length of post-treatment indwelling catheterization (P>0.05) (Table 2).

**Table 1** Comparison of Baseline Characteristics Among Four Groups of Patients

| Variables | AFS Group (59 Patients) | TVT-O Group (61 Patients) | Mucosal Flap Group (62 Patients) | ASIS Group (61 Patients) | F/$\chi^2$-value | P-value |
|---|---|---|---|---|---|---|
| Age, year | 56.64±8.95 | 56.44±8.35 | 57.24±7.27 | 57.81±7.61 | 0.064 | 0.938 |
| Number of deliveries, times | 3.28±1.49 | 3.80±1.85 | 3.60±1.68 | 3.50±1.41 | 0.610 | 0.546 |
| Stature, cm | 157.88±5.08 | 157.00±5.44 | 155.80±6.06 | 156.74±5.81 | 0.888 | 0.416 |
| Height, kg | 57.36±6.58 | 57.56±6.85 | 56.48±7.68 | 57.04±6.99 | 0.166 | 0.847 |
| Body mass index, kg/m2 | 23.03±2.89 | 23.20±1.92 | 23.22±2.45 | 23.67±2.67 | 0.082 | 0.921 |
| Menopausal status, n(%) | 46(77.97) | 49(80.33) | 55(88.71) | 53(86.89) | 1.560 | 0.458 |
| Presence of diabetes, n(%) | 27(45.76) | 36(59.02) | 26(41.94) | 31(50.82) | 0.901 | 0.637 |
| Presence of hypertension, n(%) | 30(58.82) | 27(44.26) | 38(61.29) | 29(47.54) | 0.787 | 0.675 |

**Table 2** Comparison of Perioperative Variables Among Four Groups of Patients X±S, ($P_{25}$, $P_{75}$)

| Perioperative Variables | AFS Group (59 Patients) | TVT-O Group (61 Patients) | Mucosal Flap Group (62 Patients) | ASIS Group (61 Patients) | F/U-value | P-value |
|---|---|---|---|---|---|---|
| Operative time, min | 121.40±11.90[a,b,c] | 65.29±13.08[a] | 86.74±12.64[a,b] | 40.56±10.57 | 25.133 | 0.008 |
| Urinary catheterization, days | 3 (2, 3) | 2 (2, 3) | 2 (2, 4) | 1 (1, 2) | 2.618 | 0.270 |
| Duration of hospitalization, days | 7.48±1.81[a,b] | 5.76±1.75[a] | 7.28±1.77[a,b] | 4.36±2.03 | 10.691 | <0.001 |
| Intraoperative blood loss volume, mL | 114.80±17.35[a,b,c] | 68.00±13.56[a] | 85.20±16.51[a,b] | 51.37±15.49 | 31.052 | <0.001 |
| Hospitalization cost, RMB | 14200.73±794.36[a,b] | 22602.97±853.03 | 16,461.95±610.50[a,b] | 23982.38±688.56 | 670.507 | <0.001 |

**Notes**: [a]Compared with the ASIS group, P<0.05; [b]Compared with the TVT-O group, P<0.05; [c]Compared with the mucosal group, P<0.05.

## Clinical Outcomes

When the total effective rate following therapy was compared between the four patient groups, there was no statistically significant difference (P>0.05) (Table 3).

## Severity of Incontinence and Quality of Life

ICI-Q-SF scores and IIQ-7 scores were significantly lower and I-QOL scores were significantly higher in all four groups post-treatment compared to before treatment (P<0.05). Following treatment, the AFS group's ICI-Q-SF scores were considerably higher than those of the ASIS group (P<0.05) (Table 4).

## Urodynamic Indicators

There was no significant difference in the MUCP, VLPP and FUL among the four groups before treatment and post-treatment (P>0.05); the urodynamic indicators of the four groups post-treatment were all significantly larger than before treatment (P<0.05) (Table 5).

Table 6 displays the pertinent parameters of pressure-flow studies, including MFR, AFR, VT, voiding volume, detrusor pressure at opening (Pdet-Opening), and detrusor pressure at maximum flow (Pdet-Max Flow). There was no statistically significant discrepancy in pressure-flow study parameters among the four patient groups before and after treatment (P>0.05). These findings suggest that the voiding dysfunction observed in the four patient groups was not attributed to detrusor overactivity or bladder outlet obstruction.

## Lower Urinary Tract Anatomy

The four groups' post-treatment BND, PUVA and URA were all significantly higher than their post-treatment values (P<0.05) (Table 7).

## Post-Treatment Complications

In comparison to other three groups, the TVT-O group experienced a statistically significant higher incidence of post-treatment pain in the medial thigh or inguinal area(P<0.05). Between the AFS group and the other three groups, the incidence of post-treatment urine retention was considerably higher (P<0.05). There was no statistically significant difference in the incidence of post-treatment dysuria, urinary tract infection, dyspareunia and bladder injury among the four groups of patients (P>0.05) (Table 8).

**Table 3** Comparison of Therapeutic Effects Among Four Groups of Patients After Treatment [n(%)]

| Effects | AFS Group (59 Patients) | TVT-O Group (61 Patients) | Mucosal Flap Group (62 Patients) | ASIS Group (61 Patients) | $\chi^2$-value | P-value |
|---|---|---|---|---|---|---|
| Cure,(n%) | 49 (83.05) | 55 (90.16) | 54 (87.10) | 58 (95.08) | | |
| Improvement,(n%) | 7 (11.86) | 4 (6.56) | 5 (8.06) | 2 (3.28) | | |
| Invalid,(n%) | 3 (5.08) | 2 (3.28) | 3 (4.84) | 1 (1.64) | | |
| Total effective,(n%) | 56 (94.92) | 59 (96.72) | 59 (95.16) | 60 (98.36) | 8.900 | 0.769 |

**Table 4** Comparison of IIQ-7 Scores, ICI-Q-SF Score and I-QOL Score Before and After Treatment Among Four Groups of Patients

| Groups | IIQ-7 | | | | ICI-Q-SF | | | | I-QOL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pretherapy | Post-Treatment | t/Z-value | P-value | Pretherapy | Post-treatment | t/Z-value | P-value | Pretherapy | Post-Treatment | t/Z-value | P-value |
| AFS group (59 patients) | 12.40±1.85 | 6.32±1.65 | 19.237 | <0.001 | 12.64±1.68 | 6.92±1.56[a] | 13.796 | <0.001 | 58.05±5.24 | 84.82±5.09 | 13.414 | 0.039 |
| TVT-O group (61 patients) | 12.88±2.65 | 6.08±1.53 | −4.412 | 0.040 | 13.96±2.88 | 6.04±1.54 | −4.396 | <0.001 | 57.98±6.27 | 85.73±6.00 | −4.390 | <0.001 |
| Mucosal flap group (62 patients) | 12.32±2.36 | 6.26±1.57 | −4.418 | <0.001 | 13.12±2.44 | 6.13±1.39 | −4.400 | <0.001 | 58.59±5.82 | 84.73±6.05 | −4.388 | <0.001 |
| ASIS group (61 patients) | 13.00±2.75 | 6.14±2.39 | 10.423 | <0.001 | 14.13±3.06 | 5.39±2.11 | 15.410 | 0.027 | 58.93±4.89 | 85.92±5.18 | 11.250 | <0.001 |
| F/U-value | 0.430 | 4.799 | | | 0.263 | 7.175 | | | 0.450 | 22.671 | | |
| P-value | 0.652 | 0.101 | | | 0.770 | 0.091 | | | 0.640 | 0.427 | | |

**Note**: [a]Compared with the ASIS group, P<0.05.

**Abbreviations**: ICIQ-UI-SF, International Consultation on Incontinence Questionnaire–Urinary Incontinence Short Form; IIQ-7, Incontinence Impact Questionnaire Short Form; I-QOL, Incontinence Quality of Life Questionnaire.

**Table 5** Comparison of Urodynamic Indicators Before and After Treatment Among Four Groups of Patients

| Groups | Maximum Urethral Closure Pressure, $cmH_2O$ | | | | Functional Urethral Length, mm | | | | Valsalva Leak Point Pressure, $cmH_2O$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pretherapy | Post-Treatment | t/Z-value | P-value | Pretherapy | Post-Treatment | t/Z-value | P-value | Pretherapy | Post-Treatment | t-value | P-value |
| AFS group (59 patients) | 62.48±3.74 | 77.98±2.84 | −4.389 | <0.001 | 25.84±2.91 | 30.80±2.96 | 9.036 | <0.001 | 80.44±6.92 | 109.52±7.86 | 28.500 | <0.001 |
| TVT-O group (61 patients) | 63.12±4.13 | 78.12±4.50 | 23.238 | <0.001 | 25.88±2.74 | 29.92±3.43 | 13.608 | 0.015 | 80.68±5.77 | 110.40±5.39 | 47.688 | <0.001 |
| Mucosal flap group (62 patients) | 63.92±4.78 | 79.16±6.30 | 30.836 | 0.034 | 26.08±3.76 | 30.52±3.60 | −4.434 | <0.001 | 81.36±7.15 | 108.96±8.59 | 59.118 | 0.018 |
| ASIS group (61 patients) | 64.10±4.28 | 79.45±5.19 | 25.167 | <0.001 | 26.05±4.00 | 31.01±3.81 | 6.157 | 0.037 | 81.07±6.48 | 111.00±6.94 | 30.124 | <0.001 |
| F/U-value | 0.725 | 26.008 | | | 0.041 | 3.360 | | | 0.129 | 21.074 | | |
| P-value | 0.488 | 0.084 | | | 0.960 | 0.140 | | | 0.879 | 0.342 | | |



https://doi.org/10.2147/IJWH.S488235

**Table 6** Comparison of Pressure Flow Study Before and After Treatment Among Four Groups of Patients

| Variables | AFS Group (59 Patients) | | | | TVT-O Group (61 Patients) | | | | Mucosal Flap Group (62 Patients) | | | | ASIS Group (61 Patients) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pretherapy | Post-Treatment | t-value | P-value | Pretherapy | Post-Treatment | t-value | P-value | Pretherapy | Post-Treatment | t-value | P-value | Pretherapy | Post-Treatment | t-value | P-value |
| Voiding Volume(mL) | 370.02±10.45 | 322.97±12.06 | 23.429 | 0.406 | 364.00±12.36 | 333.47±15.45 | 28.157 | 0.501 | 359.16±17.10 | 337.85±16.80 | 20.032 | 0.159 | 361.29±18.91 | 328.33±9.02 | 24.590 | 0.374 |
| VT(s) | 24.90±12.37 | 31.16±11.25 | 14.011 | 0.218 | 28.15±10.09 | 36.02±9.07 | 13.489 | 0.127 | 29.61±7.84 | 32.10±10.23 | 17.014 | 0.213 | 26.12±12.04 | 33.34±7.90 | 19.018 | 0.685 |
| AFR(mL/s) | 12.30±5.80 | 10.80±7.00 | 19.224 | 0.142 | 15.38±3.59 | 11.14±5.81 | 17.450 | 0.150 | 13.42±4.89 | 12.10±6.11 | 19.468 | 0.910 | 16.05±7.06 | 14.82±6.17 | 16.996 | 0.140 |
| MFR(mL/s) | 23.20±10.51 | 22.91±9.30 | 15.125 | 0.740 | 22.60±3.13 | 20.68±6.99 | 19.408 | 0.133 | 24.11±7.82 | 22.90±5.23 | 16.989 | 0.645 | 25.12±15.60 | 24.51±7.05 | 20.364 | 0.716 |
| Pdet-Opening($cmH_2O$) | 19.71±10.90 | 24.30±12.80 | 21.264 | 0.229 | 20.72±9.52 | 25.08±7.26 | 18.430 | 0.491 | 22.14±13.00 | 25.19±6.74 | 15.251 | 0.547 | 23.73±7.69 | 26.41±5.76 | 22.21 | 0.512 |
| Pdet-Max Flow(cmH2O) | 18.24±10.78 | 23.20±10.14 | 31.156 | 0.890 | 17.78±7.35 | 22.68±13.91 | 33.549 | 0.336 | 18.73±8.87 | 22.18±6.21 | 39.718 | 0.480 | 19.89±12.45 | 21.16±14.02 | 26.120 | 0.181 |



https://doi.org/10.2147/IJWH.S488235

**Table 7** Comparison of Urinary Structure Indicators Before and After Treatment Among Four Groups of Patients

| Groups | Bladder Neck Descent, mm | | | | Posterior Urethra-Vesical Angle,° | | | | Urethral Rotation Angle,° | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pretherapy | Post-Treatment | t/Z-value | P-value | Pretherapy | Post-Treatment | t/Z-value | P-value | Pretherapy | Post-Treatment | t-value | P-value |
| AFS group (59 patients) | 28.40±7.46 | 22.59±6.79 | 20.419 | <0.001 | 153.84±9.03 | 139.82±8.21 | 19.036 | <0.001 | 55.00±13.70 | 41.60±7.51 | 38.500 | 0.027 |
| TVT-O group (61 patients) | 29.01±6.48 | 21.06±7.62 | 19.425 | <0.001 | 156.12±9.37 | 141.28±8.61 | 23.608 | 0.019 | 56.40±14.10 | 40.21±9.30 | 27.688 | <0.001 |
| Mucosal flap group (62 patients) | 29.24±7.15 | 21.37±8.01 | 31.617 | 0.045 | 154.28±8.95 | 140.19±9.10 | −14.434 | <0.001 | 55.78±16.00 | 41.30±8.50 | 49.118 | 0.034 |
| ASIS group (61 patients) | 28.94±7.80 | 20.89±7.15 | 4.159 | <0.001 | 155.46±10.02 | 142.00±8.79 | 6.249 | <0.001 | 57.10±15.40 | 40.78±8.16 | −12.407 | <0.001 |
| F/U-value | 0.318 | 0.809 | | | 0.594 | 0.749 | | | 0.545 | 0.756 | | |
| P-value | 0.753 | 0.320 | | | 0.546 | 0.267 | | | 0.651 | 0.575 | | |



https://doi.org/10.2147/IJWH.S488235

**Table 8** Comparison of Post-Treatment Complications Among Four Groups of Patients [n(%)]

| Groups | AFS Group (59 Patients) | TVT-O Group (61 Patients) | Mucosal Flap Group (62 Patients) | ASIS Group (61 Patients) | $\chi^2$-value | P-value |
|---|---|---|---|---|---|---|
| Groin pain,(n%) | 3 (5.08)[a] | 9 (14.75) | 1 (1.61)[a] | 2 (3.28)[a] | 9.525 | 0.005 |
| Dysuria,(n%) | 2 (3.39) | 3 (4.92) | 1 (1.61) | 1 (1.64) | 2.163 | 0.537 |
| Urinary retention,(n%) | 8 (13.56) | 4 (6.56)[b] | 3 (4.84)[b] | 2 (3.28)[b] | 0.432 | 0.024 |
| Urinary tract infection,(n%) | 1 (1.69) | 2 (3.28) | 1 (1.61) | 2 (3.28) | 1.818 | >0.999 |
| Dyspareunia,(n%) | 2 (3.39) | 2 (3.28) | 1 (1.61) | 3 (4.92) | 4.591 | 0.486 |
| Bladder injury,(n%) | 4 (6.78) | 2 (3.28) | 3 (4.84) | 1 (1.64) | 5.640 | 0.301 |

**Notes**: [a]Compared with the TVT-O group, P<0.05; [b]Compared with the AFS group, P<0.05.

## Discussion

This study reveals a lack of significant difference in the effectiveness of various surgical approaches in the treatment of SUI in women. The results of this study suggest that bleeding, hospitalization time, and operative time were significantly reduced in the ASIS procedure. TVT-O procedure increases the incidence of medial thigh pain. There is also an elevated probability of urinary retention after AFS. SUI is the most common of the various types of urinary incontinence. With the aging of the population, the incidence of the disease is increasing year by year. The most common risk factors for SUI in women are advanced age, high BMI, diabetes mellitus and chronic coughing.[8] For patients who have failed conservative treatment or have moderate-to-severe SUI, surgical treatment is currently the mainstay of clinical practice to improve symptoms. There are various types of SUI surgery and each surgical procedure has its own features. For the surgical treatment of SUI, "Midurethral Slings" have become the most widely used clinical procedure since Delancey[9] suggested the "hammock" concept. TVT-O procedure reduces risk of pelvic organ injury. But artificial slings increase the risk of sling exposure. Unlike artificial material slinging, AFS surgery can use the autologous fascia as a sling. This reduces the risk of mesh invading and lowers the incidence of post-treatment urinary tract infection. Likewise, using your own vaginal epithelial padding, vaginal epithelial flap mid-urethral suspension greatly strengthens the support of the urethra while lowering the risk of epithelial injury and decreasing organism damage. With improved technology of the slings, the ASIS procedure has been progressively implemented in clinical practice. The ASIS has the advantage of less trauma, a shorter recovery period and low complication rate. The short-term therapeutic efficacy of ASIS has been validated with cure rates ranging from 82–91.4%.[10,11] Choosing the right treatment plan for the patient's own condition, such as whether she has diabetes or whether she has combined pelvic organ prolapse. This is why there are a variety of clinical procedures to accommodate the different needs of patients. For example, mucosal flap suspension of the anterior vaginal wall in patients with combined anterior vaginal wall prolapse reduces the symptoms of anterior vaginal wall prolapse. The AFS procedure avoids the erosive effect of mesh. In order to investigate the efficacy of four surgical modalities for the treatment of SUI and to identify the advantages and disadvantages of each surgical modality, we examined the efficacy of several surgical modalities in treating SUI in women in this study.

According to the study's findings, there was no discernible difference between the four surgical modalities' efficacy in treating SUI in women. These findings are consistent with a reticulated meta-analysis conducted by Liang Yunxiao et al.[12] The TVT-O treatment offers advantages like less bleeding and less damage, which are good for the patient's healing after surgery. The TVT-O group in this study had a shorter operative time, shorter hospital stay and less intraoperative bleeding than the AFS group and epithelial flap group. This finding aligns with the outcomes of Maryse et al's comprehensive review and meta-analysis.[13] According to this study statistics, the TVT-O group had a significantly higher incidence of post-treatment medial thigh pain than the other three patient groups. The reason behind this could be that the patient's medial thigh required to be punctured during the procedure, which could harm the muscle there or compress the obturator nerve branch when wearing a sling.[14] Three of the patients in the TVT-O group in this study experienced dysuria and four of them experienced post-treatment urine retention. It is possible that these patients experienced urinary retention as a result of overtightening their sling contraction.[15] Slings constructed from autologous tissues have emerged as a superior choice for the treatment of SUI since they do not have the incidence of long-term complications associated with artificial slings or the erosion that occurs after using

synthetic materials. The study conducted by Athanasopoulos has demonstrated[16] the clear effectiveness of autologous fascial slings in the management of SUI. Following AFS, eight patients in this study experienced post-treatment urinary retention and two other patients experienced post-treatment dysuria, which may have been primarily caused by too tight suspension or an incorrect bladder neck suspension position. In this study, four patients had AFS surgery and suffered bladder injuries. These injuries could have been brought on by the operator's inexperience or application of brute force during the puncture without tightening the pubic bone. The use of vaginal epithelial flaps in the treatment of SUI has been reported in recent years.[17–19] Suspension through the vaginal epithelial flap can make up for the absence of pelvic floor support structures and increase treatment effectiveness by using the detached vaginal wall to reinforce the weak areas.[20] Additionally, there is no risk of implanted mesh rejection or mesh invading of the surrounding tissues.[5] Three patients in the epithelial flap group in this study experienced post-treatment urinary retention. This condition was likely brought on by the clinicians' decision to place the epithelial flap at an excessively high suspension point on the anterior vaginal wall, which led to an abnormally high urethral angle and post-treatment urinary retention in the patients.[6] The primary benefit of the fourth generation of the ASIS is its ability to manipulate the tension of the sling in both directions, so ensuring optimal lower urethral support to achieve the intended therapeutic impact and reducing the rate of post-treatment dysuria and urine retention. The ASIS group of patients experienced the least amount of intraoperative bleeding out of the four patient groups because ASIS avoids tissues that are prone to damage. A meta-analysis conducted by Fuding et al[21] showed that there was no significant difference between ASIS and other slings in patients cure rate. In addition, ASIS was associated with a significantly shorter operative time and lower post-treatment pain score. According to the findings of the MOSTAFA et al study,[22] the ASIS technique allowed patients to resume their regular activities and jobs one week sooner than the TVT-O operation. This study's ASIS group also had the shortest hospital stay and surgical duration. Because of its short puncture path, lack of damage to the medial thigh muscle groups, the ASIS procedure lowers the risk of developing post-treatment thigh root discomfort. Two patients in the ASIS group of the 61 patients in this study experienced mild post-treatment pinprick pain in the medial thigh root, which both patients' symptoms resolved in two weeks. The source of the discomfort may reveal that it is due to either localized tissue edema compression brought on by sling and anchor irritation or irritation of the occluder nerve terminals. There was no significant difference in the incidence of post-treatment dyspareunia among the four patient groups in this study, suggesting that the ASIS did not impair the patients' sexual function. Three patients in the ASIS group experienced post-treatment dyspareunia, which was understandable given that the surgery caused scarring and contracture of the vagina.

Recent studies have proposed urethral bulking agent (UBA) for the treatment of SUI. This procedure can be used to treat SUI by injecting fillers into the urethra or periurethral tissues to expand the surface area of the local urethra and increase urethral pressure. Some studies have shown that UBA is more effective for stress incontinence in women 60 years and older, with a 90% cure rate.[23] Stem cells have also been proposed to treat SUI by inducing myoblast differentiation to repair the damaged urethral sphincter. A prospective study demonstrated the safety and efficacy of stem cell injection therapy for SUI patients.[24] However, further research is required to observe its safety and efficacy because there is still a dearth of evidence from large-sample clinical trials. According to some research, localized injectable platelet-rich fibrin has a high effectiveness rate and no negative side effects when used to treat SUI.[25] Some researchers have also proposed the use of low-intensity extracorporeal shock waves for the treatment of SUI. A Chinese randomized controlled experiment found that low-intensity extracorporeal shockwave therapy significantly improves quality of life for people with SUI.[26] It has the potential to be a new, noninvasive, widely available treatment for SUI.

In conclusion, there was no nominal difference in the substantial efficacy of all four surgical techniques used to treat female stress urine incontinence. Less intraoperative bleeding and a shorter operating duration are benefits shared by both TVT-O and ASIS. Both AFS and epithelial flap midurethral suspensions do not increase the possibility of mesh band invasion or foreign body rejection. From a clinical perspective, it is important to understand the benefits and drawbacks of various surgical techniques and tailor a surgical approach to the individual patient's needs based on the particular problem.

## Abbreviations

SUI, stress urinary incontinence; TVT-O, tension-free vaginal tape-obturator; AFS, autologous fascial retropubic mid-urethral sling; ASIS, adjustable urethral suspension with a single incision; ICI-Q-SF, Incontinence Questionnaire-Urinary Incontinence Short Form; I-QOL, Incontinence Quality of Life Questionnaire; IIQ-7, Incontinence Impact Questionnaire

Short Form; FUL, functional urethral length; MUCP, maximum urethral closure pressure; VLPP, Valsalva leak point pressure; BND, bladder neck mobility; PUVA, posterior urethral vesico-vaginal angle; URA, urethral rotation angle; MUS, Midurethral Slings; TVT, Transvaginal Tension-free Vaginal Tape; UBA, urethral bulking agent.

## Data Sharing Statement

The data analyzed for this study can be accessible from the corresponding author on reasonable request.

## Ethical Approval

All procedures followed were in accordance with the Helsinki Declaration. This study has been approved by the Ethical Committees of Minda Hospital of Hubei Minzu University (Y2024024). As the type of study in this trial is a retrospective analysis of the original data, the above Ethics Committee has approved the waiver of patient consent.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Funding

This research received no external funding.

## Disclosure

Ms.Zhuo is a graduate student in obstetrics and gynecology at Hubei University for Nationalities. Dr Chaoyan is a preceptor for Ms.Zhuo. The study took place in Minda Hospital affiliated with Hubei University for Nationalities. This research received no external funding. All authors declare no conflict of interest.

## References

1. Chmaj-Wierzchowska K, Raba G, Dykczyński P, et al. Clinical outcomes of Mid-Urethral Sling (MUS) procedures for the treatment of female urinary incontinence: a multicenter study. *J Clin Med*. 2022;11(22):6656. doi:10.3390/jcm11226656
2. Cheng LQ, Yuan XY. Research progress and prospect of female stress urinary incontinence. *J Clin Surg*. 2024;32(2):135–139.
3. Osman Nadir I, Hillary Christopher J, Altaf M, et al. The midurethral fascial "sling on a string": an alternative to midurethral synthetic tapes in the era of mesh complications. *European Urol*. 2018;74(2):191–196. doi:10.1016/j.eururo.2018.04.031
4. Gu R, Wang JJ, Gong J, et al. Analysis of the efficacy of autologous tissue repair for moderate and severe pelvic organ prolapse. *China Matern Child Health Res*. 2016;27(8):1021–1023.
5. Gao Y, Huang HW. Effect of mucosal flap autosuspension of anterior vaginal wall on the improvement of pelvic floor function in patients with pelvic organ prolapse. *China Matern Child Health*. 2017;32(09):2030–2032.
6. Qiang R, Zheng YH, Xie QH, et al. Comparison of the results of anterior vaginal wall mucosal flap suspension and traditional anterior vaginal wall repair for the treatment of anterior pelvic organ prolapse. *Clin Med Engineer*. 2019;26(01):47–48.
7. Gynecologic Pelvic Floor Group of the Chinese Medical Association Obstetrics and Gynecology Section. Guidelines for the diagnosis and treatment of female stress urinary incontinence (2017). *Chinese J Obstetrics Gynecol*. 2017;52(5):289–293.
8. Pang H, Lv J, Xu T, et al. Incidence and risk factors of female urinary incontinence: a 4-year longitudinal study among 24 985 adult women in China. *Bjog*. 2022;129(4):580–589. doi:10.1111/1471-0528.16936
9. DeLancey JO. Structural support of the urethra as it relates to stress urinary incontinence: the hammock hypothesis. *Am J Obstet Gynecol*. 1994;170(6):1713–1720. doi:10.1016/S0002-9378(12)91840-2
10. Abdel-Fattah M, Agur W, Abdel-All M, et al. Prospective multi-centre study of adjustable single-incision mini-sling (Ajust(®)) in the management of stress urinary incontinence in women: 1-year follow-up study. *BJU Int*. 2012;109(6):880–886. doi:10.1111/j.1464-410X.2011.10471.x
11. Cornu JN, Peyrat L, Skurnik A, et al. Ajust single incision transobturator sling procedure for stress urinary incontinence: results after 1-year follow-up. *Int Urogynecol J*. 2012;23(9):1265–1270. doi:10.1007/s00192-012-1740-0
12. Liang YX, He TJ, Weierdon, et al. Reticular Meta-analysis of long-term efficacy and complications in different surgical procedures. *General Pract China*. 2020;23(08):949–958.
13. Maryse L, Zi Zheng MM, Yang EC, et al. Synthetic vs nonsynthetic slings for female stress and mixed urinary incontinence: a systematic review and meta-analysis. *Am J Clin Exp Obstet Gynecol*. 2024;S0002–9378(24):1–29.
14. Zalewski M, Kołodyńska G, Zalewska A, et al. Comparative assessment of female sexual function following transobturator midurethral sling for stress urinary incontinence. *Int J Environ Res Public Health*. 2021;18(5):2286. doi:10.3390/ijerph18052286

15. Cong ZC, Qiu DD. Analysis of the efficacy of closed-column midurethral tension-free suspension for the treatment of stress urinary incontinence and risk factors for post-treatment transient urinary retention. *China Matern Child Health*. 2018;33(7):1651–1654.
16. Athanasopoulos A, Gyftopoulos K, McGuire EJ. Efficacy and preoperative prognostic factors of autologous fascia rectus sling for treatment of female stress urinary incontinence. *Urology*. 2011;78(5):1034–1038. doi:10.1016/j.urology.2011.05.069
17. Zhuo XC, Zhong XY, Huang PN. Efficacy analysis of anterior vaginal wall mucosal flap midurethral suspension with post-treatment pelvic floor rehabilitation therapy for the treatment of anterior pelvic organ prolapse combined with tension urinary incontinence. *Chinese Med Sci*. 2020;10 (24):105–108+112.
18. Chen JJ, Xia ZJ, Xu HN, et al. Clinical discussion of anterior vaginal wall valve autotransplantation for pressure urinary incontinence. *J China Med University*. 2013;42(10):918–923.
19. Zhang H, Chen JM, Wang GH. Clinical analysis of midsection urethral suspension. *Med Theory Pract*. 2019;32(24):4030–4031.
20. Wang LJ, Wang HX, Jian T. Analysis of the efficacy of stress urinary incontinence. *Modern Diagnosis Ther*. 2023;34(13):1984–1986.
21. Bai FD, Chen JM, Zhang Z, et al. Adjustable single-incision mini-slings (Ajust®) versus other slings in surgical management of female stress urinary incontinence: a meta-analysis of effectiveness and complications. *BMC Urol*. 2018;18(1). doi:10.1186/s12894-018-0357-0
22. Mostafa A, Agur W, Abdel-All M, et al. A multicentre prospective randomised study of single-incision mini-sling (Ajust®) versus tension-free vaginal tape-obturator (TVT-O™) in the management of female stress urinary incontinence: pain profile and short-term outcomes. *Eur J Obstet Gynecol Reprod Biol*. 2012;165(1):115–121. doi:10.1016/j.ejogrb.2012.06.022
23. Elmelund M, Sokol ER, Karram MM, et al. Patient characteristics that may influence the effect of urethral injection therapy for female stress urinary incontinence. *J Urol*. 2019;202(1):125–131. doi:10.1097/JU.0000000000000176
24. Li PC, Ding DC. Stem-cell therapy in stress urinary incontinence: a review. *Tzu Chi Med J*. 2023;35(2):111–119. doi:10.4103/tcmj.tcmj_145_22
25. Ü M U. The effect of injectable platelet rich fibrin as a nonsurgical treatment of the female stress urinary incontinence. *Arch Gynecol Obstet*. 2024;309(5):2229–2236. doi:10.1007/s00404-024-07431-3
26. Lin KL, Chueh KS, Lu JH, et al. Low intensity extracorporeal shock wave therapy as a novel treatment for stress urinary incontinence: a randomized-controlled clinical study. *Medicina*. 2021;57(9). doi:10.3390/medicina57090947