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Full length article

Long-term outcome of the retropubic TVT procedure for women with stress urinary incontinence: 20–25-year follow-up

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ABSTRACT

Introduction: Stress urinary incontinence (SUI) significantly affects women's quality of life. The tension-free vaginal tape (TVT) procedure has demonstrated short- and medium-term efficacy, but data beyond 15 years remain scarce. This study evaluates the 20- to 25-year outcomes of the retropubic TVT procedure in terms of efficacy, safety, and patient satisfaction.

Methods: This retrospective cohort study included 135 women that underwent the retropubic TVT procedure between 1998 and 2003. All surgeries were performed by two surgeons using the Gynecare TVT™ Sling. Data were obtained from medical records, follow-ups, and telephone interviews (January–March 2024). Outcomes were assessed using the Patient Global Impression of Improvement (PGI-I), International Consultation on Incontinence Questionnaire–Urinary Incontinence Short Form (ICIQ-UI SF), and Urinary Distress Inventory–Short Form (UDI-6).

Results: Out of 593 women originally treated, 135 completed long-term follow-up. The mean age at surgery was 50.3 years and 72.5 years at follow-up. The median PGI-I score of 2.0 indicated that 76.3 % of patients reported significant improvement. The median ICIQ-SF score was 7.0, reflecting moderate symptom burden, and the median UDI-6 score was 22.2, with 20 % of patients reporting significant urgency symptoms. Postoperative complications were low; 85.9 % of patients had no complications, 13.3 % experienced urinary retention, and 0.7 % had tape erosion. Repeat TVT was required in 9.6 % of cases, with significantly lower satisfaction ($p = 0.002$). PGI-I scores strongly correlated with ICIQ-SF ($r = 0.801$, $p < 0.01$) and UDI-6 ($r = 0.676$, $p < 0.01$).

Conclusions: TVT remains an effective long-term SUI treatment with high satisfaction and low complications. Long-term follow-up is essential for monitoring late-onset complications.

Introduction

Uncontrolled leakage of urine, or urinary incontinence (UI), is a pelvic floor dysfunction encountered in patients across all age groups. It involves any involuntary leakage of urine that poses a social, health, and hygiene burden for the patient, necessitating changes in lifestyle and imposing limitations on daily activities [1]. Patients report a wide variety of symptoms and signs, with a broad spectrum of severity. These issues range from mildly bothersome to severely restrictive. Due to its chronic nature, UI significantly affects the quality of life of women as well as their families or caregivers [2].

Stress urinary incontinence (SUI) is defined as a complaint of involuntary loss of urine on effort or physical exertion (e.g., sports activities), or on sneezing or coughing according to a joint report by the International Urogynecological Association (IUGA) and International Continence Society (ICS) on terminology for female pelvic floor dysfunction [3]. The term "activity-related incontinence" might be preferred in some languages to avoid confusion with psychological stress [3]. Although lifestyle modifications and pelvic floor exercises might help, in some cases surgery is needed. In 1994 the tension-free vaginal tape (TVT) operation was introduced. It was invented by Ulf Ulmsten, a Swedish gynecologist. Ulmsten and his team introduced this minimally invasive surgical technique for the treatment of SUI in women [4,5]. The method involved placing a synthetic mesh tape under the mid-urethra to

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provide support to prevent leakage during physical activities. This "tension-free" approach reduced complications associated with earlier procedures that relied on more invasive techniques [6].

The TVT operation gained widespread acceptance due to its high success rate, simplicity, and quicker recovery compared to traditional surgical methods, such as Burch colposuspension [4,7]. The widespread acceptability of the TVT procedure was also significantly supported by a large prospective multicenter randomized controlled trial comparing TVT with colposuspension, conducted by Ward and Hilton. Their results demonstrated comparable short- and medium-term efficacy with faster recovery and fewer postoperative complications for TVT, supporting its adoption as a first-line surgical treatment for stress urinary incontinence [8,9]. Over time, variations of the original TVT procedure, such as transobturator tape (TOT) and the mini-sling, were developed to further refine the technique.

Over the past 2 decades, the TVT procedure has been widely adopted, and numerous studies have documented its efficacy and safety in the short to medium term, with a follow-up as long as 13 years. These studies have consistently shown positive outcomes, with many patients experiencing significant improvements in continence and quality of life [10–12]. However, data on the long-term outcomes of the TVT procedure, particularly beyond 15 years, remain scarce. To the best of our knowledge, there have been only six studies with a follow-up longer than 15 years: Bakas et al. [13] and Nilsson et al. [14] have published studies with a 17-year follow-up, and Braga et al. [15], Goessens et al. [16], and Soderini et al. [17] have published studies with a 20-year follow-up. O'Leary et al. [18] analyzed patient-reported outcomes of TVT after 16 to 24 years. This gap in knowledge is concerning, given the potential for late-onset complications, such as mesh erosion, chronic pain, and recurrence of incontinence.

Long-term follow-up studies are essential to fully understand the durability of the TVT procedure and its impact on patients' health over extended periods. Such studies can provide valuable insights into the longevity of the procedure's benefits and the incidence of any long-term adverse effects. This information is crucial for informing clinical practice, guiding patient counseling, and shaping future research and development in SUI treatment. Although some previous studies have evaluated long-term TVT outcomes, our study extends follow-up to 20 to 25 years, making it one of the longest available.

This 20- to 25-year follow-up study evaluates the long-term outcomes of the TVT procedure. Specifically, we seek to assess the durability of continence, the incidence of late-onset complications, and overall patient satisfaction.

Materials and methods

This retrospective cohort study included women that underwent the retropubic TVT procedure between 1998 and 2003 at the Ljubljana University Medical Center. All surgeries were performed by two experienced surgeons, ensuring consistency in surgical technique. The retropubic TVT tapes used in all procedures were obtained from the same manufacturer, maintaining uniformity in the type and quality of the material used (Gynecare TVT™ Sling Retropubic System, Johnson & Johnson, Somerville, NJ, USA). Inclusion criteria at the time of surgery required a clinically or urodynamically confirmed diagnosis of SUI (defined in urodynamic lab investigation either with urinary leakage on pad testing (more than 1 g/hour) and confirmed with a depression quotient on urethral pressure profile during cough). At follow-up, all women older than 90 were excluded because of the increased possibility of response bias in such patients.

Data were obtained from medical records and follow-up visits, with additional patient interviews conducted with all patients included between January 2024 and March 2024 via telephone calls. Primary outcomes included patient satisfaction, continence status, and severity of UI assessed with standardized questionnaires: the Patient Global Impression of Improvement (PGI-I) [19], the International Consultation on Incontinence Questionnaire–Urinary Incontinence Short Form (ICIQ-UI SF) [20,21], and the Urinary Distress Inventory–Short Form (UDI-6) [22]. The ICIQ-SF as a patient questionnaire for UI is the only available validated questionnaire in Slovenian [23]. Patient-reported success was defined as a response of "very much better" or "much better" on the PGI-I questionnaire. All other responses ("a little better," "the same," "a little worse," "much worse," and "very much worse") were considered to indicate treatment failure [24]. By simplifying the PGI-I variable into two distinct categories ("improved" and "failure"), we sought to gain a clearer picture of the treatment efficacy for each sling procedure. Information about postoperative complications and the need for further surgical or non-surgical interventions was obtained via case notes and clinical examination reports of postoperative visits.

The study protocol was approved by the Institutional Ethics Committee (*Komisija za strokovno etična vprašanja*, KSEV; Ljubljana University Medical Center), approval number 00123–2023. The confidentiality of personal data was ensured following the principle of good clinical data protection practice, and in line with the Declaration of Helsinki and the Slovenian Code of Medical Ethics and Deontology. All participants provided verbal informed consent. Patient confidentiality was maintained through anonymization of data and secure storage of records.

Statistical analysis

All statistical analyses were performed with SPSS (version 28). For categorical variables we calculated frequencies and percentages, and for continuous variables we first assessed the distribution by applying the Shapiro–Wilk test and visual inspection of Q–Q plots. The age-related measures approximated a normal distribution and are therefore expressed as mean ± standard deviation. In contrast, the main outcome measures (PGI-I, ICIQ-SF, and UDI-6) were not normally distributed and are therefore reported as median and interquartile range (IQR).

In addition, comparisons of non-normally distributed data (e.g. PGI-I, ICIQ-SF, and UDI-6) between two groups (e.g., repeat TVT vs. no repeat TVT, or bulking agent vs. none) were performed using the Mann–Whitney *U* test, and Kendall's tau was used to assess correlations between PGI-I, ICIQ-SF, and UDI-6.

All significance tests were two-tailed tests with $p < 0.05$ as the threshold for statistical significance.

Results

A total of 593 women that underwent the TVT procedure between 1998 and 2003 were screened for eligibility for the 20-year follow-up study. Of these, 312 women were lost to follow-up. Among the remaining 281 women, 53 had died and 93 were over the age of 90 at the time of the interview and were therefore excluded from the study. All remaining eligible women consented to participate. Ultimately, 135 women were enrolled in the study and completed the follow-up

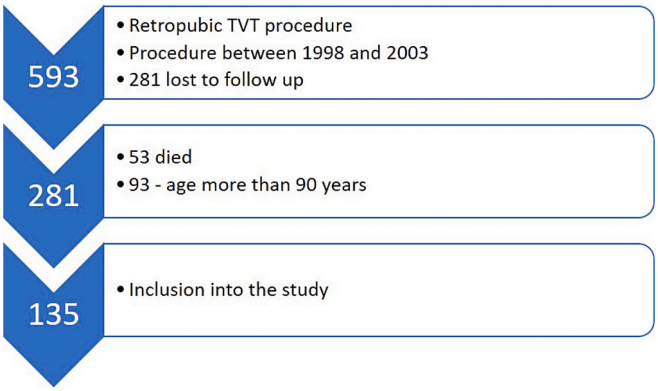

Fig. 1. Flow diagram of patient selection. TVT = tension-free vaginal tape.

interviews (Fig. 1).

At surgery, the mean age of patients was 50 years ($SD = 6.94$); see Table 1. By the follow-up, their mean age had risen to around 72 ($SD = 7.00$), which reflects the lengthy interval since their initial procedures. The standard deviation of around 7 years in both measurements implies that most patients fell within a 14-year band around those averages.

In terms of follow-up distribution over the years, 16.3 % of patients were assessed in year 20 post-surgery, with the proportion gradually increasing to a peak of 23.0 % at year 23 before declining to 7.4 % by year 25 (Table 2).

The PGI-I had a median score of 2.0, meaning that most participants rated themselves as "much improved," which is consistent with the 103/135 patients (76 %) that reported overall improvement. The ICIQ-SF median score at follow-up was 7 and the UDI-6 median score was 22.22, indicating moderate symptom burden and urinary symptoms, respectively. However, the wide interquartile ranges illustrate that some patients had very mild symptoms, whereas others had more pronounced severity.

Postoperative complications were relatively low, with 116/135 patients (85.9 %) reporting no complications. Among those that did experience issues, 18/135 patients (13.3 %) had urinary retention, whereas only 1/135 (0.7 %) developed tape erosion.

Regarding surgical revisions, the vast majority of patients, 132/135 (97.8 %), did not require further intervention. Only 2/135 patients (1.5 %) underwent tape loosening, and one patient (1/135) required tape excision.

Table 3 presents Kendall's tau correlation coefficients among PGI-I, ICIQ-SF, and UDI-6 scores. The significant correlations indicate that a higher PGI-I is associated with lower scores on both the ICIQ-SF and UDI-6 measures. Specifically, the correlation between PGI-I and ICIQ-SF is 0.801 ($p < 0.01$), suggesting a strong association. The correlation between PGI-I and UDI-6 is 0.676 ($p < 0.01$), indicating a moderately strong association, and correlation between ICIQ-SF and UDI-6 is 0.647 ($p < 0.01$), also indicating a moderately strong association.

During long-term follow-up, additional interventions to treat persistent or recurrent symptoms were rare. Of the 135 patients, only two required a bulking agent injection, and their mean PGI-I rank was higher (indicating relatively poorer satisfaction) than patients that did not receive this treatment. However, the difference was not statistically significant ($p = 0.196$). Thirteen patients underwent one repeat TVT procedure. Their PGI-I rank was significantly higher compared to those that did not require a second surgery, and this difference reached statistical significance ($p = 0.002$).

In addition to examining repeat TVT and bulking-agent use, we tested whether participants that received treatment for UUI/overactive bladder (UUI/OAB) differed from those that did not in terms of PGI-I, ICIQ-SF, or UDI-6 scores. UUI/OAB treatment included pharmacotherapy, treatment with botulinum toxin, electrical stimulation, or magnetic stimulation. Mann–Whitney U tests revealed no statistically significant differences (PGI-I: $U = 1{,}074.50$, $z = -0.86$, $p = 0.39$; ICIQ-SF: $U = 1{,}203.50$, $p = 0.97$; UDI-6: $U = 1{,}018.00$, $p = 0.24$). Likewise, patients that underwent additional gynecological surgeries (hysterectomy: vaginal, laparoscopic, or via laparotomy; salpingo-oophorectomy; vaginoplasty; or wide local excision of a vulval lesion) showed no significant score differences compared to those without such procedures (PGI-I: $U = 1{,}454.00$, $p = 0.99$; ICIQ-SF: $U = 1{,}423.00$, $p = 0.85$; UDI-6: $U = 1{,}235.00$, $p = 0.22$). These results suggest that neither UUI/OAB therapy nor other gynecological interventions substantially altered patients' global improvement, symptom severity, or urinary distress at long-term follow-up.

Table 1
Patient characteristics.

Variable	Category	N (%)	Mean	SD
Age on the day of the operation	Numerical variable	135(100)	50.3	6.9
Age at follow-up			72.5	7.0
Partus			2.1	0.7
Previous surgeries	No surgeries	74 (54.81)	–	–
	Hysterectomy	36 (26.67)	–	–
	Cesarean section	4 (2.96)	–	–
	Anterior Colporaphy	6 (4.44)	–	–
	Burch colposuspension	7 (5.19)	–	–
	Other	9 (5.93)	–	–

Table 2
Follow up (TVT – Tension-free Vaginal Tape; UUI – urgency urinary incontinence; OAB – overactive bladder; PGI-I – Patient Global Impression of Improvement; ICIQ-SF – International Consultation on Incontinence Questionnaire; UDI-6 – Urinary Distress Inventory – Short Form).

Variable	Category	N (%)	Mdn	IQR
Post-surgery complications	none	116 (85.9)	–	–
	urinary retention	18 (13.3)	–	–
	tape erosion	1 (0.7)	–	–
Revision surgery	no	132 (97.8)	–	–
	tape loosening	2 (1.5)	–	–
	tape excision	1 (0.7)	–	–
Hysterectomy in the follow-up period	yes	28 (20.74)	–	–
	no	107 (79.26)	–	–
Repeat TVT	yes	13 (9.63)	–	–
	no	122 (90.37)	–	–
Bulking agent application	yes	2 (1.48)	–	–
	no	133 (98.52)	–	–
UUI/OAB treatment	yes	23 (17.04)	–	–
	no	112 (82.96)	–	–
Follow up	20 years	22 (16.3)	–	–
	21 years	26 (19.3)	–	–
	22 years	26 (19.3)	–	–
	23 years	31 (23.0)	–	–
	24 years	20 (14.8)	–	–
	25 years	10 (7.4)	–	–
PGI-I		135(100)	2.0	2.0
	improved	103 (76.30)	–	–
	failure	32 (23.70)	–	–
ICIQ-SF	Numerical variable	135(100)	7.0	13.0
UDI-6	Numerical variable	135(100)	22.22	22.22
% of UDI-6 > 33.33 %	Numerical variable	27 (20)	–	–

Table 3
Correlation between PGI-I, ICIQ-SF, and UDI-6 (Kendal Tau for Study Variables; PGI-I – Patient Global Impression of Improvement; ICIQ-SF – International Consultation on Incontinence Questionnaire; UDI-6 – Urinary Distress Inventory – Short Form); $^{**}p < 0.01$.

Variable	1	2	3
1. PGI	—		
2. ICIQ-SF score	0.801**	—	
3. UDI-6	0.676**	0.647**	—

Discussion

To our knowledge, this is the first article to show the outcome of TVT with a 20- to 25-year follow-up. The results confirm that the TVT procedure remains an effective long-term treatment for SUI. The follow-up distribution over the years demonstrates robust long-term patient tracking, which is essential for assessing the durability of the TVT

procedure. The analysis demonstrates stable outcomes over 2 decades, with significant correlations between PGI-I scores and symptom severity, as measured by ICIQ-SF and UDI-6. Although these scores were assessed only at follow-up and do not reflect a change from baseline, they provide valuable insight into patients' symptom burden decades after surgery. Patients that reported greater satisfaction also experienced lower urinary distress and better continence control. Notably, follow-up length was not significantly associated with these scores, suggesting that the benefits of the procedure persist long-term without substantial deterioration.

The findings of our study align with previous long-term studies. Bakas et al. (2019) reported an objective cure rate of 83.9 % and a subjective cure rate of 78.6 % at 17 years, with complications such as tape erosion (1.75 %) and recurrent urinary tract infections (3.5 %) being relatively rare. In comparison, Nilsson et al. (2013) found a slightly higher objective cure rate of 91.3 % and a subjective improvement rate of 87.2 %, with only one minor case of tape extrusion reported. Goessens et al. (2023) documented similar outcomes, with a subjective cure rate of 85 % and an objective cure rate of 90 %, but they highlighted a higher prevalence of overactive bladder symptoms (30.3 %). Braga et al. (2022), with a 20-year follow-up, found that 82 % of patients were objectively cured and 75 % subjectively cured, also noting a low complication rate but a gradual decline in satisfaction over time due to aging-related factors and the development of new urinary symptoms. A recent study by Soderini et al. (2025) provided a 20-year follow-up study of Argentine women that underwent the TVT procedure, reporting exceptionally high objective and subjective cure rates (96.8 % and 95.3 %, respectively). The study included urogynecological examinations, cough stress tests, and uroflowmetry as part of its objective assessments, demonstrating the continued efficacy of TVT in a Latin American population. Notably, Soderini et al. observed no cases of long-term voiding dysfunction, supporting the procedure's safety profile in extended follow-up [17]. In addition, O'Leary et al. (2023) provided important long-term data on TVT outcomes over a median follow-up of 20 years. They found that 39.3 % of women reported no stress urinary incontinence (SUI) at follow-up, whereas urgency symptoms were prevalent, affecting 42.1 % of patients. Despite the persistence of some urgency and overactive bladder symptoms, the overall satisfaction remained high, with a median satisfaction score of 98/100, and 92.4 % of women stated they would choose to undergo the procedure again. Importantly, bladder pain and dyspareunia were rare, and the impact of urinary symptoms on quality of life was generally low [18]. Although long-term success rates remain high across studies, some studies report a gradual decline in subjective satisfaction, likely due to aging-related factors and the emergence of new urinary symptoms.

The safety profile of the TVT procedure in our cohort is favorable, with low complication rates after surgery. Postoperative complications, such as urinary retention (13.3 %) and tape erosion (0.7 %), were minimal. Surgical revisions were rare, with 97.8 % of patients not requiring additional interventions, highlighting the long-term effectiveness and reliability of the TVT procedure. Only a small percentage required adjustments, including 1.5 % that underwent tape loosening and 0.7 % that required tape excision. These cases likely reflect individual variations in healing, implant response, or surgical technique. Urinary retention remains a key consideration following mid-urethral sling procedures, with varying rates depending on the surgical approach. In our follow-up study, urinary retention was observed in 13.3 % of patients, whereas a separate study conducted at the same institution analyzing outcomes of TVT-Abbrevo, TVT-O, and single-incision Ophira Mini Sling reported an acute retention rate of 9.1 % [25]. This aligns with reported MUS retention rates in the literature, which range from 1.5 % to 6.6 %, although our findings for retropubic TVT fall on the higher end [25]. Despite these differences, both studies confirm that retention is typically transient. Notably, no patient in our 20- to 25-year follow-up required long-term catheterization or tape revision due to voiding dysfunction, indicating that, although post-TVT urinary retention is an important consideration, it does not appear to compromise the long-term efficacy and safety of the procedure.

Other studies corroborate these results. For example, Nilsson et al. (2013) and Goessens et al. (2023) reported similarly low rates of tape-related complications and revisions. Although rare, complications such as recurrent urinary tract infections and de novo urgency symptoms highlight the need for individualized follow-up and management.

Urgency, a common symptom associated with overactive bladder (OAB), was assessed in this study using UDI-6 scores. Approximately 20 % of patients reported scores indicative of significant urgency-related distress (UDI-6 $>$ 33.33). However, the correlation between follow-up length and urgency severity was minimal and not statistically significant, suggesting that urgency symptoms do not substantially worsen over time after TVT surgery. This finding aligns with Goessens et al. (2023), who reported a 30.3 % prevalence of OAB symptoms at follow-ups beyond 15 years (16).

Although a subset of patients reported urgency symptoms and received treatments for OAB (such as medications or Botox injections), statistical analysis revealed no significant differences in patient-reported outcomes—including PGI-I, ICIQ-SF, and UDI-6 scores—between those that experienced urgency symptoms and those that did not. Although patients receiving OAB treatments exhibited slightly higher (i.e., worse) PGI-I scores compared to untreated patients, this difference was not statistically significant.

Overall, these results suggest that urgency symptoms, although common and clinically relevant for some patients, did not have a substantial impact on long-term satisfaction or perceived urinary distress in this cohort. This finding contrasts with some previous reports in which OAB symptoms were associated with poorer outcomes and may reflect differences in symptom severity, treatment effectiveness, or evolving patient expectations over an extended follow-up period. Importantly, urgency as a postoperative complication may arise from altered bladder dynamics, aging-related changes, or underlying comorbidities, emphasizing the need for individualized patient management.

Re-intervention was rare, with only two patients receiving bulking agent injections and 13 undergoing repeat TVT. Although bulking agent use showed no significant impact on satisfaction ($p = 0.196$), patients that underwent repeat TVT reported significantly lower satisfaction ($p = 0.002$). This suggests that repeat TVT may be linked to suboptimal initial outcomes or progressive SUI.

This study has limitations that should be acknowledged. The retrospective design and reliance on patient-reported outcomes introduce potential recall bias. The ICIQ-SF and UDI-6 are symptom-specific tools evaluating the severity and distress of urinary symptoms, whereas the PGI-I provides a global assessment of perceived improvement. Therefore, correlations between these instruments should be interpreted with the understanding that they capture complementary but distinct dimensions of treatment outcomes. In addition, the high attrition rate (53 % of the original cohort was lost to follow-up) and exclusion of women over 90 may limit the generalizability of the findings. Because only the ICIQ-UI SF is formally validated in Slovenian, any correlation that involves the non-validated PGI-I or UDI-6 must be interpreted with caution.

High attrition over 2 decades and exclusion of women older than 90 inevitably limited the final sample size, reducing the power to detect small differences or rare complications, and potentially biasing the results toward those that were still accessible and willing to participate. In addition, the absence of systematic clinical reexamination at long-term follow-up may have led to an underestimation of asymptomatic complications, such as mesh erosions. Complication rates were assessed based on medical record review and patient-reported outcomes, rather than on objective clinical examination at follow-up.

Although the use of only subjective assessment of urinary continence is a limitation, research suggests that a patient's subjective assessment is a good indicator of actual surgical success, but some discrepancies occur. In a 10-year TVT-O follow-up study conducted by Tamma et al.,

66 % of women had both a negative stress test and no subjective leaks, and only one patient considered herself cured subjectively despite an objective failure. In contrast, a subset (about 12 % of patients) had an objective cure (dry on testing) but did not report a subjective cure [26]. This means that a positive subjective report (patient "feels cured") has a high predictive value for an objective cure, whereas a negative subjective report does not always mean objective failure. Indeed, some women may be objectively continent but still report dissatisfaction or residual incontinence symptoms. One early study after TVT noted an objective cure rate of about 89 % but a subjective cure rate of only about 66 %, a significant gap attributed largely to de novo urgency symptoms lowering patients' perceived success [27,28]. In other words, new or persisting urinary symptoms (e.g., urgency or frequency) can cause patients to report treatment failure despite the elimination of stress leakage. Overall, however, when patients report being continent or much improved (via tools like PGI-I), it usually correlates with objective findings of cure, whereas patient-reported lack of improvement may signal issues such as urgency or partial relief rather than true sling failure. Long-term studies confirm this correlation. Nilsson et al., Goessens et al., Bakas et al., Braga et al., and Soderini et al. found that high objective cure rates over 17 to 20 years consistently align with high subjective cure rates [13–17]. Although factors such as age and urgency can influence individual perception, subjective assessments obtained with validated instruments such as the PGI-I are a reliable measure of long-term surgical success.

Future research should aim to identify predictors of long-term success and complications to optimize patient selection, evaluate interventions for managing urgency and other late-onset symptoms, and conduct prospective studies with larger cohorts and standardized follow-up protocols.

We should not forget to mention concerns about long-term complications from synthetic vaginal mesh and tape procedures, which have led to increased restrictions worldwide. Pelvic mesh insertion was halted in the UK in 2018 and in the US in 2019, and TVT and mid-urethral slings have been removed from clinical use in both the UK and New Zealand due to safety concerns. Women that developed mesh-related complications often faced delayed diagnosis, difficulty obtaining care, and dismissal of their concerns by healthcare providers. Formal inquiries, including the Cumberlege Report in the UK, as well as investigations in Scotland and Australia, documented substantial shortcomings in patient care and widespread distress. The withdrawal of TVT and mid-urethral slings in some countries further underscores the urgent need for long-term outcome data on surgical treatments for SUI. Nevertheless, in countries where TVT remains in use, comprehensive patient counseling, shared decision-making, and continued long-term follow-up are essential to ensure informed consent and patient safety [29–31].

Our findings reaffirm TVT as a reliable and durable surgical option for SUI. Clinicians should emphasize the procedure's long-term benefits while counselling patients about the potential for late-onset urgency and the need for occasional retreatments. Individualized management strategies, informed by patient-specific factors such as age and comorbidities, are essential for optimizing outcomes. By integrating these insights into clinical practice, we can enhance patient education, refine treatment strategies, and improve quality of life for women with SUI. The importance of long-term follow-up cannot be overstated because it provides critical data on the sustainability and safety of interventions like the TVT procedure.

Conclusions

The findings of this study confirm that the TVT procedure is a reliable and effective long-term treatment for SUI in women. Over 2 decades, the procedure demonstrated stable symptom relief, high patient satisfaction, and minimal complications. Although urgency symptoms were observed in a subset of patients, they did not significantly affect overall satisfaction. These results reaffirm the TVT procedure as a cornerstone of SUI management, emphasizing the importance of long-term follow-up to monitor and address any late-onset complications or symptoms.

CRediT authorship contribution statement

Vojka Lebar: Writing – original draft, Investigation, Data curation. **Adolf Lukanović:** Writing – review & editing, Supervision, Methodology, Funding acquisition. **Miha Matjašič:** Writing – review & editing, Software, Formal analysis, Data curation. **Matija Barbič:** Writing – review & editing. **David Lukanović:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Statement of ethics.

This study was reviewed and approved by the Institutional Ethics Committee (*Komisija za strokovno etična vprašanja* / KSEV; Ljubljana University Medical Center), approval number 00123-2023. The confidentiality of personal data was ensured following the principle of good clinical data protection practice, and in line with the Declaration of Helsinki and the Slovenian Code of Medical Ethics and Deontology.

Informed verbal consent was obtained from all subjects involved in the study.

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Data availability

The data that support the findings of this study are not publicly available because they contain information that could compromise the privacy of research participants; however, they are available from the corresponding author upon reasonable request.

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