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Long-term Outcomes of Trans Obturator Midurethral Sling Procedure in the Treatment of Female Stress Urinary Incontinence: the Same Surgeon, Surgical Technique, and Material

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What's known on the subject? and What does the study add?

Transobturator mid-urethral sling (TO-MUS) is widely used for female stress urinary incontinence, but long-term data remain limited. Prior studies are often heterogeneous with respect to surgical technique, surgeon experience, and sling material, which limits their generalizability. This study provides long-term outcomes (median follow-up of 125 months) of TO-MUS performed by a single surgeon, using a uniform technique and material. High treatment success (83.3%) and patient satisfaction (92.8%), with no mesh-related complications, demonstrate the durability and safety of TO-MUS under standardized conditions.

Abstract

Objective: To evaluate the long-term outcomes of the transobturator mid-urethral sling (TO-MUS) procedure for the treatment of female stress urinary incontinence (SUI) when performed by a single surgeon using a standardized surgical technique and the same material.

Materials and Methods: Patients (n=42) who underwent TO-MUS between 2006 and 2023 were retrospectively analyzed. Inclusion criteria were a diagnosis of urodynamic SUI confirmed by the International Continence Society Uniform Cough Stress Test and a minimum follow-up duration of 12 months. Treatment success was defined as no pad use and a negative response to item 6 of the International Consultation on Incontinence Questionnaire-Short Form. Patient satisfaction was assessed via structured telephone interviews. The treatment success and patient satisfaction rates were compared between patients with follow-up periods above and below ten years. Group 1 comprises patients with follow-up durations ranging from 12 to 120 months, while Group 2 consists of patients with follow-up durations of 121 months or more.

Results: With a median follow-up of 125 months (range: 12-204). Group 1 (n=24) had a median follow-up duration of 69.5 months, while Group 2 (n=18) had a median follow-up duration of 154 months. TO-MUS was the primary intervention in 92.9% of patients. Across all patients, treatment success and patient satisfaction rates were 83.3% (35/42) and 92.8% (39/42), respectively. No statistically significant differences were observed between the two groups. *De novo* urgency was reported in 16.6% of patients; one patient experienced persistent voiding difficulty. Three patients (7.1%) required reoperation. No mesh-related complications were observed.

Conclusion: This study presents one of the longest follow-up periods (more than 10 years) among single-surgeon, single-center TO-MUS case series. High long-term treatment success and satisfaction rates, together with low complication and reoperation rates support the durability and safety of the TO-MUS procedure in carefully selected patients when it is performed by experienced surgeons using standardized techniques and surgical materials.

Keywords: Complication, female, mesh, stress urinary incontinence, TOT, urodynamics

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Introduction

Mid-urethral sling (MUS) procedures have become the gold-standard surgical treatment for stress urinary incontinence (SUI) in women, owing to their minimally invasive nature and favorable short- to mid-term outcomes. Among these, the transobturator MUS (TO-MUS) is widely adopted due to its lower risk of bladder injury and shorter operative time than the retropubic (RP) approach (1,2). However, long-term data on TO-MUS procedures, particularly those performed by the same surgeon whose surgical technique and choice of mesh material remained unchanged over the study period, are scarce. Another limitation in many prior studies has been heterogeneity in surgical techniques, surgeon experience, and patient selection. Moreover, few studies have assessed both objective and subjective measures of success, together with long-term safety, under standardized conditions. In addition to outcome variability, there is increasing concern about procedure-related complications, such as mesh exposure, *de novo* urgency, and voiding dysfunction, all of which may contribute to patient dissatisfaction. The TO-MUS procedure has been increasingly de-emphasized in certain guidelines and has even been prohibited in some countries (3). However, the growing negative climate surrounding TO-MUS lacks evidence-based support from data obtained in long-term studies conducted in standardized clinical settings. This study aims to address this gap by presenting long-term outcomes of TO-MUS procedures performed using a uniform surgical technique and mesh material in a well-defined patient cohort.

Materials and Methods

Study Design and Patient Selection

Following the institutional review board approval from Koç University Ethics Committee (approval number: 2025.339. IRB2.161, date: 31.07.2025), the medical records of all female patients who underwent TO-MUS using the same surgical technique and material (Boston Scientific Obtryx II Transobturator Mid-urethral Sling System®) between 2006 and 2023 were retrospectively reviewed. Eligible patients had received TO-MUS as primary or secondary treatment for SUI and had a minimum postoperative follow-up of 12 months.

Patients with morbid obesity (body mass index ≥30) and/or those who could not be reached by telephone or were lost to follow-up were excluded. It should be noted that the early years of the study (2006-2015) relied on paper-based records, and accessing archived files posed difficulties. Some patient files were incomplete or could not be retrieved due to archival limitations, contributing to the number of unreachable patients. No patient was excluded based on clinical outcome; the only reason for exclusion was the absence of sufficient follow-up information.

Preoperative Assessment

All patients underwent a standardized preoperative evaluation, which included pelvic examination for the assessment of pelvic organ prolapse (POP), graded according to the Baden-Walker system, and assessment of urethral mobility using the Q-tip test. Urethral hypermobility was defined as a Q-tip excursion >300. The evaluation also incorporated the International Continence Society Cough Stress Test (ICS-Uniform CST) and invasive urodynamic studies (UDS) to confirm the diagnosis of SUI (4-7). Although the ICS-Uniform CST was formally introduced in 2018, the same standardized CST protocol—consistent with the currently accepted ICS method—had been routinely used in our clinic throughout the study period. UDS was performed after manual reduction of POP in patients with POP greater than grade 2. When POP of grade 3 or higher was identified, concomitant POP surgery (anterior and/or posterior vaginal wall repairs) was performed.

Surgical Material

The TO sling system used in this study incorporated a halo-type trocar specifically designed to facilitate passage of the device through the obturator foramen. The trocar-tip length was optimized for efficient TO insertion, and the integrated association loop enabled secure trocar engagement and straightforward removal. The system featured thin dilator legs intended to create a minimal delivery tract, thereby allowing smooth passage of the sling with reduced tissue disruption. The suburethral segment of the mesh was left unsleeved to enhance visualization and ensure precise positioning beneath the urethra. A blue centering tab marked the midpoint of the mesh, enabling equal distribution on either side of the urethra and allowing direct visualization of tension and centering during positioning and sleeve removal. The mesh consisted of de-tanged polypropylene designed to maintain structural integrity during tensioning and potentially reduce irritation of the urethral wall (8).

Surgical Technique

All procedures were performed by the same surgeon on an inpatient basis under general anesthesia, in the lithotomy position. The patient was positioned in the lithotomy position with the hips hyperflexed. A 2 cm incision was made on the anterior vaginal wall at the level of the mid-urethra. Blunt dissection was carried out laterally until the index finger contacted the inner surface of the ischiopubic ramus and the obturator foramen. Bilateral horizontal lines were drawn from the clitoral level to the inguinofemoral sulcus. A 1 cm vertical skin incision was made at each intersection of the lines with the sulcus. Sling's halo trocars were used to perforate the

obturator membrane and then directed medially, guided by a finger inserted through the vaginal incision, to emerge into the vaginal canal. The tape was mounted on the trocar and then pulled through the skin incision on each side. Tension was adjusted to ensure that the dissecting scissors could lie flat between the tape and the urethra without resistance (9,10). A cystoscopy was performed immediately after trocar insertion to assess for any inadvertent intravesical placement of the mesh and to verify bilateral ureteral patency by confirming clear efflux from both ureteral orifices. The incisions were closed using absorbable sutures. The Foley catheter was removed 12-24 hours after surgery.

In cases where concomitant POP surgery was performed, vaginal wall repair was always carried out through a separate incision, rather than using the same incision as the TO-MUS procedure.

Follow-up and Outcome Measures

Although a structured early postoperative follow-up protocol (at 1 week, 3 months, and 12 months) was routinely performed in our clinic, these visits were not included in the analysis due to inconsistent documentation over the long study period. Long-term outcomes were therefore based on standardized telephone interviews administered uniformly to all patients. Patients' current condition was assessed via structured telephone interviews conducted by the same urologist; the interviews consisted of six standardized questions evaluating continence status International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF item 6), pad use, patient satisfaction, *de novo* urgency, voiding difficulty, and any pain or symptoms suggestive of mesh-related complications. Treatment success was defined as absence of pad use and a negative response to the sixth item of the ICIQ-SF, indicating no current SUI. Patient satisfaction was defined as a self-reported improvement in urinary symptoms and an affirmative response to the question "Would you recommend this procedure to a friend with similar complaints?"

To assess whether treatment outcomes differed between patients with follow-up durations of up to 10 years and those with longer follow-up, outcomes were compared between two groups defined by follow-up duration:

- Group 1: 12 to 120 months,
- Group 2: 121 months and above.

In addition to success and satisfaction rates, any postoperative complications requiring surgical intervention were recorded, as were *de novo* urinary symptoms such as urgency or voiding difficulty.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as medians with corresponding ranges, given the non-parametric distribution of the data. Categorical variables were summarized as frequencies and percentages. Comparisons between groups were conducted using the Mann-Whitney U test for continuous variables and the chi-square or Fisher's exact test for categorical variables, as appropriate. A p-value less than 0.05 was considered statistically significant.

Results

During the study period (2006-2023), a total of 59 TO-MUS procedures were performed using the same standardized technique and sling material. Among these, 42 patients were successfully reached for long-term follow-up and were included in the analysis. Seventeen patients were excluded due to the inability to contact them despite multiple attempts. The median age was 53 years (range, 34-69 years). TO-MUS was performed as the primary treatment in 39 patients (92.9%) and as a secondary intervention in 3 patients (7.1%) with a history of SUI surgery. All patients had increased urethral mobility, a positive ICS-Uniform CST, and invasive UDS demonstrating SUI. The overall median follow-up duration was 125 months (range, 12-204). The overall treatment success rate was 83.3% (35/42), while the patient satisfaction rate was 92.8% (39/42). Concomitant POP surgeries were performed in 5 patients: 3 anterior wall repair, 1 posterior wall repair, and 1 anterior and posterior wall repair. Regarding safety, 92.8% (39/42) of patients did not require additional intervention for TO-MUS related complications. However, 7 patients (16.6%) developed *de novo* urgency, and 1 patient (2.3%) reported persistent voiding difficulty. Patients who developed *de novo* urgency were managed with oral pharmacotherapy. The patient with persistent voiding difficulty underwent a tape-cut procedure.

A total of 3 patients (7.1%) underwent reoperation. None of those were in the concomitant POP surgery group. All patients reported symptom resolution following the revision procedure and reported no further issues:

- Two patients underwent tape-cut (1 groin pain, 1 difficult micturition),
- One patient underwent re-TO-MUS procedure due to persistent SUI.

Group 1 (n=24, 57.1%) had a median follow-up duration of 69.5 months, while Group 2 (n=18, 42.9%) had a median follow-up duration of 154 months. Outcomes stratified by follow-up duration are presented in Figure 1. There were no statistically significant differences between the two groups in treatment success rates and patient satisfaction rates. The baseline characteristics, perioperative findings, and long-term outcomes

for the entire cohort, with separate columns for each group, are presented in Table 1.

Figures 2 and 3 were constructed using data extracted from previously published studies with ≥5 years of follow-up and outcomes from our own cohort, which were included for direct comparison.

Discussion

MUS were widely regarded as the gold standard for the surgical treatment of female SUI. However, following a 2019 communication from the U.S. Food and Drug Administration (11), the safety and long-term efficacy of these procedures have come under increased scrutiny. Additionally, the National

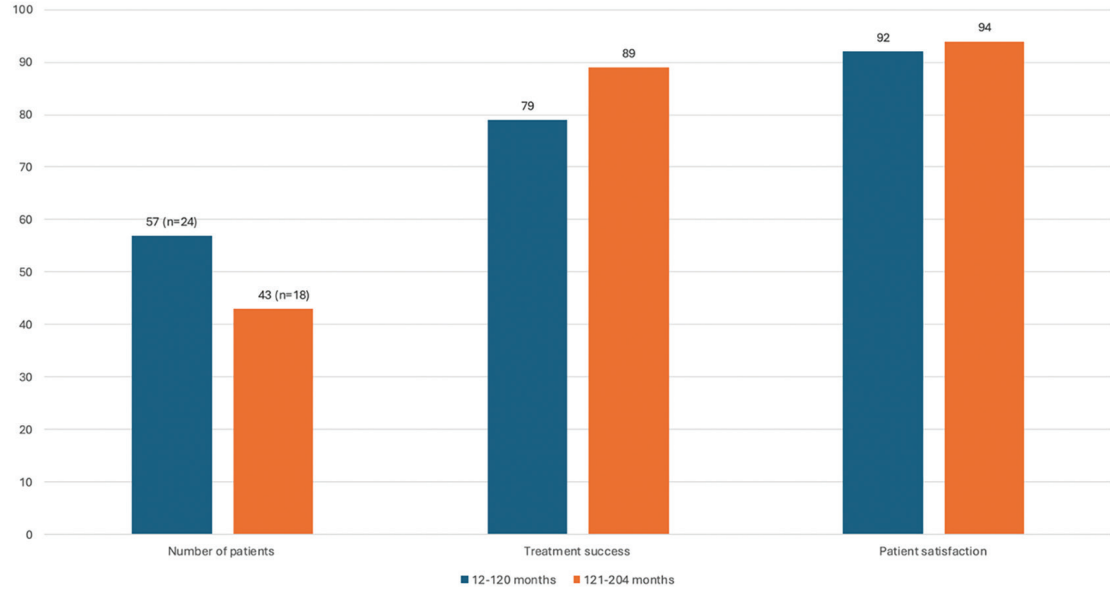

Figure 1. Number of patients (%, n), treatment success (%), and patient satisfaction (%) rates with respect to follow-up duration

Table 1. The baseline characteristics, perioperative findings, and long-term outcomes of the entire cohort, including separate columns for Groups 1 and 2

Parameter	Overall (n=42)	Group 1 (12-120 months, n=24)	Group 2 (≥121 months, n=18)
Baseline characteristics			
Age, median (range), years	53 (34-69)	53.5 (34-66)	50 (34-69)
Urethral hypermobility (%)	100%	100%	100%
Prior SUI surgery (%)	7.1% (3/42)	4.8% (2/42)	2.3% (1/42)
Perioperative features			
Concomitant POP surgery	11.9% (5/42)	3/42	2/42
Intraoperative complications	0	0	0
TO-MUS material	Obtryx II (uniform)	Same	Same
Surgical technique	Standardized (uniform)	Same	Same
Outcomes			
Median follow-up, months	125 (12-204)	69.5 (12-119)	154 (125-204)
Treatment success (%)	83.3% (35/42)	79.2% (19/24)	88.9% (16/18)
Patient satisfaction (%)	92.8% (39/42)	91.7% (22/24)	94.4% (17/18)
De novo urgency (%)	16.6% (7/42)	7.1% (3/42)	9.5% (4/42)
Voiding difficulty (%)	2.3% (1/42)	2.3% (1/42)	0
Reoperation (%)	7.1% (3/42)	4.6% (2/42)	2.3% (1/42)
Mesh-related complications (erosion, extrusion)	0	0	0

TO-MUS: Trans obturator mid-urethral sling, SUI: Stress urinary incontinence, POP: Pelvic organ prolapse

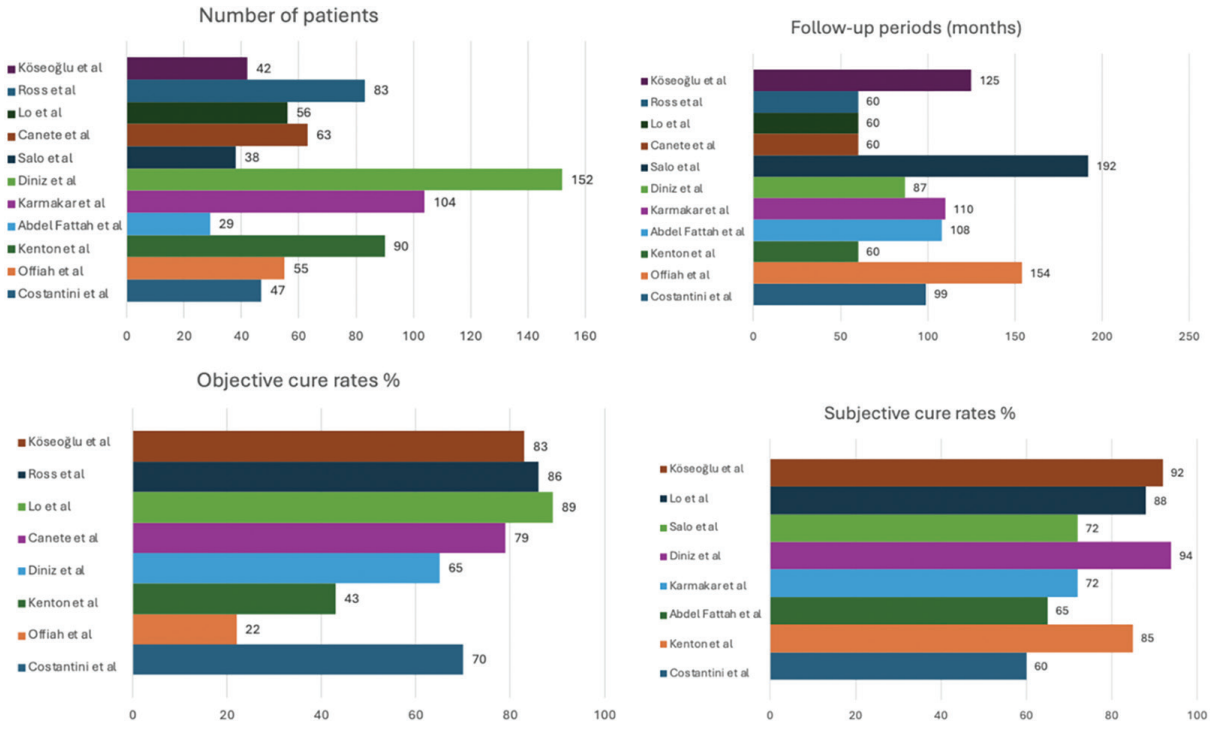

Figure 2. Cohort size (n), median follow-up duration (months), and success rates (%) in selected midurethral sling (retropubic and trans obturator) series with follow-up longer than 5 years. The figure includes data extracted from previously published studies as well as the outcomes of the present cohort, incorporated for direct comparison

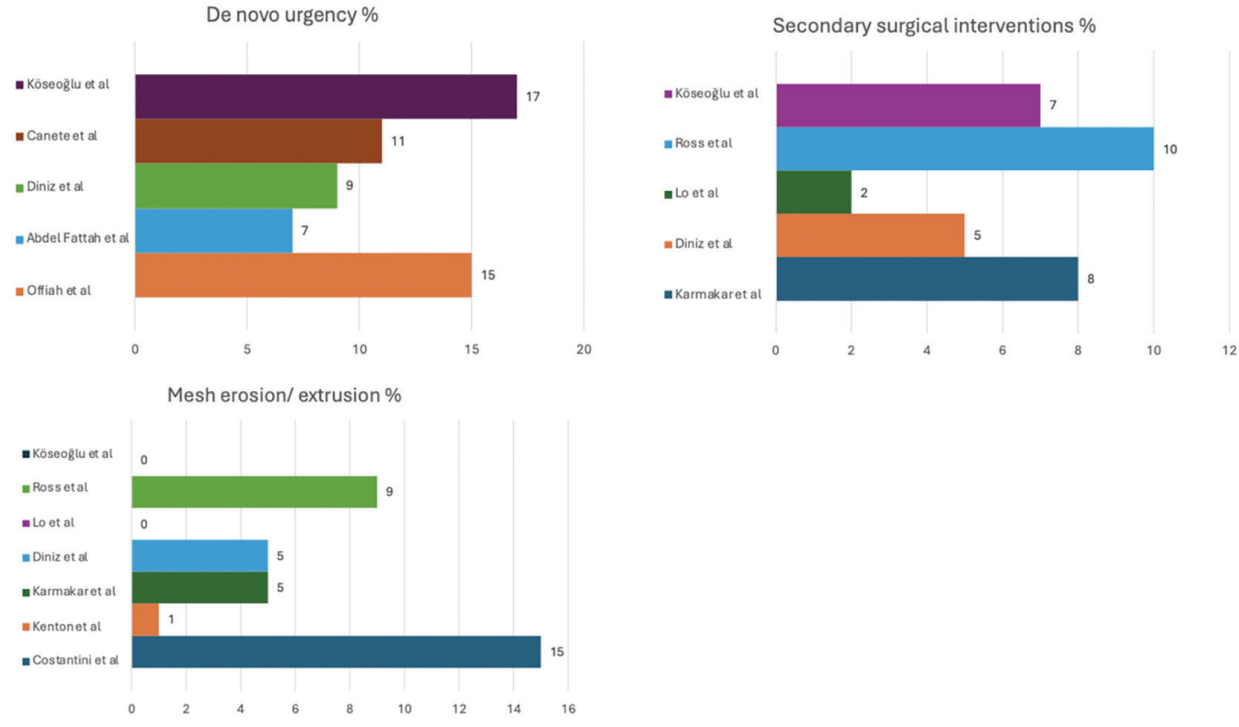

Figure 3. Rates of *de novo* urgency (%), mesh-related complications (%), and reoperation (%) in selected transobturator midurethral sling series with follow-up longer than 5 years. This figure displays both literature-derived data and the corresponding outcomes of the current study to allow comparison

Institute for Health and Care Excellence guidelines (3) excluded the TO approach from the recommended surgical options for female SUI. This recommendation was primarily based on findings from the ester systematic review (12), which suggested a higher incidence of mesh exposure associated with the TO route than the RP approach. Nevertheless, the review lacked clarity regarding the consistent use of terminology such as "erosion," "extrusion," and "exposure" across the included studies. Furthermore, most studies had relatively short follow-up durations, typically less than two years. The authors concluded that although MUS procedures appear to be more effective than alternative surgical options, there remains a significant need for robust long-term outcome data. Despite these changes, a recent survey by Karsenty (13), involving 57 urologists from 19 European countries, revealed a contrasting perspective. Of these respondents, 71% specialized in functional urology and 82% were affiliated with academic institutions. Notably, 82% of the participants reported that the TO-MUS remains their preferred surgical technique for treating female SUI (13). This finding highlights the continued clinical favorability and perceived utility of the trans obturator approach among experienced European urologists, despite evolving regulatory guidance. In this context, our study offers valuable insight by providing standardized, long-term follow-up data for TO-MUS procedures with no mesh-related complications. This finding may be explained by the uniform use of a standardized surgical technique and material combined with the expertise of the surgeon who performed all procedures, which together reduced the impact of the learning curve on clinical outcomes.

Our long-term outcomes demonstrate a success rate of 83.3% and a patient satisfaction rate of 92.8%. Objective and subjective success rates for MUS vary based on the duration of follow-up, the criteria used to define success, and the assessment tools employed, such as validated questionnaires, pad tests, or UDS. In most studies, the primary outcomes were objective treatment success and patient-reported satisfaction, commonly referred to as subjective success rates. Leone Roberti Maggiore et al. (14) conducted a systematic review and meta-analysis to evaluate the long-term effectiveness and safety of MUS procedures for SUI based on data from randomized controlled trials and non-randomized studies. Cumulative objective and subjective success rates were 61.6% and 76.5% for RP-MUS and 64.4% and 81.3% for the TO technique, demonstrating similar long-term effectiveness. In the literature, the objective and subjective success rates for all MUS among studies with a follow-up duration of more than 5 years ranged from 22% to 89% and from 64% to 97%, respectively (15-23). The wide variability in reported success rates may be attributed to the heterogeneous criteria used to define treatment success across studies. Offiah et al. (15) reported one of the lowest success rates for MUS procedures: 22% for TO-MUS and 41% for RP-MUS. In their study, treatment success was defined by a particularly stringent criterion: a response of "never" to item 9a of the ICIQ Female Lower Urinary Tract Symptoms questionnaire, which asks, "does urine leak before you can get to the toilet?". Additionally, unlike many other studies, their long-term data included patients with mixed urinary incontinence. These methodological differences underscore the lack of standardized outcome measures in the existing body of literature (Figure 2). The strict definition of treatment success used in our study (no pad use and no leakage on ICIQ-SF Q6) may underestimate clinically meaningful improvement in some patients. While this approach ensures methodological consistency and comparability with prior MUS studies using strict cure criteria, it does not capture partial improvement, which remains clinically important. Patient satisfaction outcomes were therefore reported separately to complement the primary success measure.

To maintain standardization and ensure material reliability, a single type of MUS was used across all our cases. The mesh was selected based on its long-standing clinical use, demonstrated consistent quality, and widespread availability in our country. Locally manufactured or homemade alternatives were not utilized, as they lack comparable long-term reliability and clinical validation. This selection was made to reduce variability associated with implant characteristics and did not reflect any commercial affiliation or bias. Braga et al. (24) demonstrated the importance of using a standard technique and sling material in their prospective study. They similarly demonstrated the long-term efficacy and safety of the TO approach when a standardized surgical technique and a consistent sling material (Monarch tape) were used. In their study, which included only patients with pure SUI treated by a single surgeon, objective and subjective success rates were reported as 80% and 81.4%, respectively, over a 17-year follow-up period. These outcomes are comparable to ours, reinforcing the long-term durability and reliability of the TO-MUS when performed under consistent surgical conditions. Our results are further supported by the study of Salo et al. (23), which compared the long-term outcomes of 34 RP-MUS and 38 TO-MUS procedures over a 16-year follow-up period. All procedures were performed by a single surgeon, utilizing the same type of sling material-gynecare tape for the tension-free vaginal tape group and Monarch tape for the TO-MUS group. The overall subjective success rate was 72%, with similar outcomes observed between the two surgical approaches. The standardized use of sling materials and consistent surgical technique across all cases, as in our study, underscore the importance of reducing procedural variability when assessing the long-term effectiveness of MUS.

In our cohort, *de novo* urgency was observed in 17% of patients, a rate that is consistent with the literature. Among the studies

with at least 5 years of follow-up, the incidence of *de novo* urgency ranged from 2% to 23%, whereas studies focusing exclusively on TO-MUS procedures reported rates of 7%-17% (Figure 3) (3,15,17,18,25). The interpretation of urgency symptoms in long-term follow-up remains challenging, as it is often difficult to determine whether such symptoms are directly attributable to the MUS procedure, attributable to aging, or attributable to the progression of a pre-existing condition (26).

The literature reports that the incidence of mesh-related complications associated with MUS procedures ranges from 0% to 15% (Figure 3) (17,19-21). In our study, no mesh-related complications were identified. Similarly, Lo et al. (19) reported no mesh-related complications among 56 women who underwent TO-MUS procedures, with a five-year follow-up. The absence of mesh-related complications in our cohort may be attributed to the fact that all surgeries were performed by an experienced surgeon using the same standardized technique and material. The relatively small number of TO-MUS procedures analyzed in our study does not reflect the surgeon's overall surgical volume, but rather the highly selective nature of our cohort and the institutional preference toward RP-MUS during the early and mid-2000s. The surgeon who performed all procedures is highly experienced in female and functional urology with more than 500 total procedures performed during the study period.

Study Limitations

The retrospective design, the relatively small sample size, the absence of preoperative ICIQ-SF scores, and the lack of assessment of patient satisfaction using a validated tool should be considered when interpreting the results. Another limitation of our study is that long-term outcomes were based on subjective measures, including self-reported continence status and patient satisfaction, without objective reassessment through repeat physical examination, cough stress test, pad testing, or postoperative urodynamics. Therefore, the results should be interpreted with caution, recognizing that subjective measures may either overestimate or underestimate true continence outcomes. No mesh-related complications were reported by patients during the structured telephone interview; however, since no routine postoperative physical or endoscopic examinations were performed, asymptomatic mesh exposures or erosions cannot be entirely ruled out.

Conclusion

To our knowledge, the present study is among the few that report long-term outcomes of the TO-MUS procedure in a well-defined patient population with SUI confirmed by physical examination, ICS-Uniform CST, and UDS. Homogeneity and extended follow-up strengthen our findings. The standardized technique and the use of a uniform sling material, combined with the surgeon's extensive experience in female and functional urology, likely contributed to the favorable long-term outcomes observed in this highly selected cohort. Prospective multicenter studies with larger cohorts are warranted to validate these findings and to further establish the long-term efficacy and safety of TO-MUS procedures.

Ethics

Ethics Committee Approval: The institutional review board has been approved from Koç University Ethics Committee (approval number: 2025.339.IRB2.161, date: 31.07.2025).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.K., T.T., Concept: Ö.A., T.T., Design: E.K., Ö.A., T.T., Data Collection or Processing: E.K., K.T., Analysis or Interpretation: E.K., K.T., Literature Search: E.K., K.T., Writing: E.K., Ö.A.

Conflict of Interest: No conflict of interest was declared by the authors.

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