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The comparison of magnetic and stringed stents on stent-related symptoms and quality of life: an observational study on patient-driven choice

Murat Tuğrul Eren[1,2*] and Hakan Özveri[1,3]

Abstract

Background This study compared patients with stringed versus magnetic stents regarding quality of life and stent-related discomfort throughout the stent indwelling period.

The aim of this study was to assist clinicians in selecting the appropriate type of stent considering stent-related symptoms.

Methods A total of 137 patients (56 females and 81 males) with ureteral stents were enrolled in the study. Pain scores using the visual analog scale (VAS) were recorded after surgery, before hospital discharge and prior to stent removal. Patients completed the Turkish-validated T-USSQ at stent removal to evaluate quality of life during stent indwelling period.

Results A magnetic stent was placed in 52.6% ($n=72$) of the patients while 47.4% ($n=65$) of the patients had stringed stents. VAS values were comparable between the groups.

Initially, univariate analysis showed significantly lower USSQ-Pain scores in the SS group ($p=0.026$). However, after performing multivariate adjustment for gender and stent duration, no statistically significant differences were found between MS and SS in any USSQ subdomains or VAS scores ($p>0.05$ for all).

Conclusions In this patient-selected cohort, both magnetic and stringed stents showed comparable morbidity profiles after adjusting for baseline variables. While SS may seem advantageous in univariate comparisons, these differences appear to be driven by patient demographics rather than the stent type itself.

Keywords Ureteral Stent, Magnetic Stent, Stent Related Symptoms, Patient-driven Choice, Quality of Life, Ureteral Stent Symptoms Questionnaire (USSQ)

*Correspondence:
Murat Tuğrul Eren
murat.eren@acibadem.com
[1]Department of Urology, Acıbadem Healthcare Group, Acıbadem Kozyatağı Hospital, 19 Mayıs, Kozyatağı Kavşağı No:24, Istanbul, Kadıköy 34734, Turkey
[2]Acıbadem Mehmet Ali Aydınlar University, Vocational School of Health Sciences, Head of Operating Room Services Program, Istanbul 34638, Turkey
[3]Istanbul Kent University, Vocational School of Health Sciences, Operating Room Services Program, Istanbul 34433, Turkey

Introduction

Ureteral stent placement is one of the most commonly performed urological interventions [1] However, stents may be troublesome for both patients and physicians due to their potential for causing symptomatic complications and discomfort [2]. Moreover, stent removal with cystoscopy adds more discomfort with extra costs and efforts [3, 4].

In this study, patients with stringed stents (SS) or magnetic stents (MS) were compared from the aspect of life quality indicating symptomatic stent discomfort throughout the duration of their stents' stay and removal. The results of this study aim to guide clinicians in making decisions between the two types of stents with respect to their clinical symptom differences.

Materials and methods

This prospective observational study enrolled 160 consecutive patients diagnosed with urinary tract stones who underwent endoscopic stone surgery. Preoperatively, all patients received standardized counseling regarding three available stent types. The final choice of stent was made by the patient among three types: one type requiring endoscopical removal, and two other types, either a stringed or magnetic design, enabling non-endoscopic removal. At the removal time of stents, patients who had received magnetic or stringed stents were invited to participate in the study and written informed consent was obtained. Pain intensity was evaluated using the Visual Analog Scale (VAS) and enrolled patients were asked to retrospectively assess their stent-related symptoms during the indwelling period by completing the Turkish validated ureteral stent symptom questionnaire (T-USSQ) [5–7].

The study working scheme is designed as depicted in the Flow diagram of enrollment in Fig. 1.

All precautions were taken to protect the patients' privacy and confidentiality. The study was conducted in accordance with the principles of the Declaration of Helsinki. All enrolled patients were informed about the study both by explanation in words and by written informed consent to be signed before their participation. Ethical

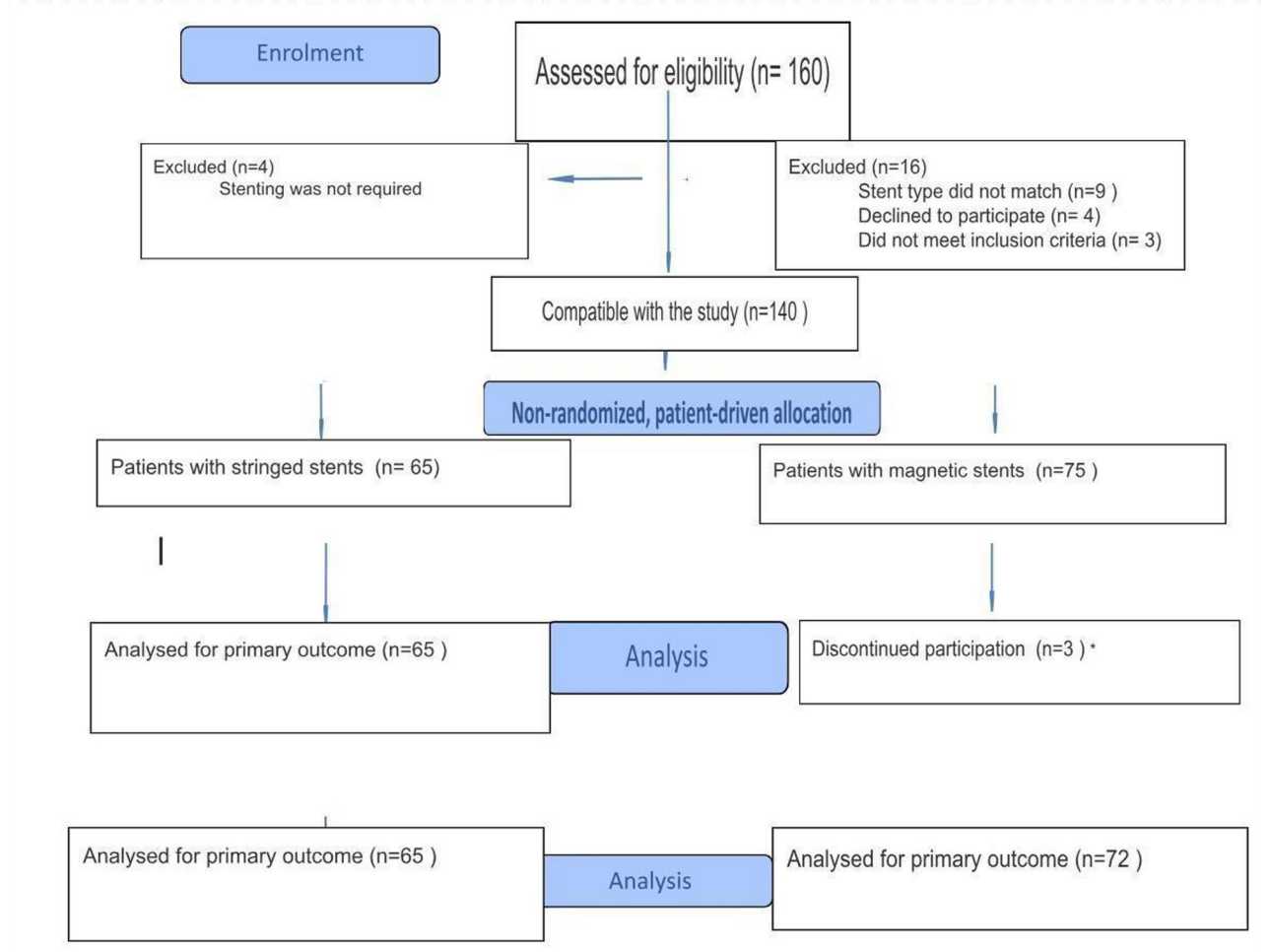

Fig. 1 Flow diagram of the progress through the phases of two stent groups

Committee approval was also obtained from Acıbadem Mehmet Ali Aydınlar University Ethical Committee.

Stone protocol computerized tomography was performed for all patients, evaluating the size (longest diameter in millimeters) and location of the stone (kidney, upper ureter, lower ureter). along with the grade of hydronephrosis. The stone size of the patients with multiple stones was determined by the sum of the longest diameters of each stone. Total blood count, creatinine levels, presence of infection proved by fever, urine examination. and urine culture results were obtained/recorded preoperatively.

All of the stents were placed at the end of the endourological stone operations. The MS (Blackstar, Urotech (Achenmühle, Germany)) is a polyurethane Double J (DJ) stent with a cylindrical-shaped magnet tipped on the distal end. Diameters of 4.8 and 6 French (F) with a 24–26 cm. length were used in this study. The SS type was the Boston Scientific DJ stent (Georgia, USA), made by Percuflex material unique to the company product at again 4.8–6 F diameters with 24–26 cm. lengths.

Requirements for analgesics and dosages were recorded postoperatively along with the duration of the hospitalization. The decision of the duration of the stent which was limited to 6–15 days was made in accordance with the past experience of the operators as determined by age, gender and clinical status of the patient. Routine non-steroid anti-inflammatory medicine was prescribed for all patients in cases of pain (Dexketoprofen 25 mg. PO. twice daily).

SSs and MSs were removed at the outpatient clinics without any medication except intra-urethral gel infusion performed by Cathejell medication, with ingredients of lidocaine hydrochloride and chlorhexidine dihydrochloride, for both analgesia and intraluminal lubricity.

Pain scores using the visual analog scale (VAS) were routinely asked to the patients after the operation, just before the discharge from the hospital and the stent removal time. Simultaneously, a Turkish validated ureteral stent symptom questionnaire (T-USSQ) was asked to be filled out by the patients at the stent removal time for evaluating their symptoms during the stented interval retrospectively.

The NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program and Python programming language (version 3.11) with statsmodels and scipy libraries were used for statistical analysis. Descriptive statistical methods (mean, standard deviation, median, frequency, percentage, minimum, and maximum) were used when evaluating the study data. The suitability of quantitative data for a normal distribution was tested with the Shapiro-Wilk test and graphical analysis. The Student's T-test was used to compare normally distributed variables between two groups; the Mann-Whitney U test was used for two-group comparisons of variables that did not show normal distribution. The Pearson Chi-Square test, the Fisher-Freeman-Halton test, and Fisher's exact test were used to compare qualitative data.

To evaluate the independent effect of stent type on outcomes and to control for potential confounding factors arising from the non-randomized design, a multivariable linear regression model (ANCOVA) was employed for all primary and secondary outcomes. In this model, baseline variables that showed statistically significant differences between the groups—specifically gender, pre-operative creatinine levels, and baseline urinalysis findings (pyuria and hematuria)—were included as covariates alongside stent duration. This expanded adjustment strategy was used to ensure that the reported differences in longitudinal VAS and USSQ scores were not attributable to these initial baseline imbalances. A p-value of < 0.05 was considered statistically significant for all adjusted analyses.

Results

140 patients compatible with the study were enrolled. Among 75 patients with MS, 2 patients were foreign nationals and their stents were removed in their home country and one patient was referred to another hospital due to the patient's demand leading to discontinuation of enrollment.

A MS was placed in 52.6% ($n = 72$) of these patients while 47.4% ($n = 65$) of the patients had SSs. The mean age was 44.33 ± 12.89 (18–81) years.

81% of the patients ($n = 111$) had solitary stones with a mean size of 8.22 ± 3.86 mm. The rest ($n = 26$) had multiple stones (mean total size = 16.96 ± 7.92 mm.). In 122 patients, stones were located at only the kidney or one portion of the ureters (lower or upper), while 15 cases had their stones at multiple locations (at both the kidney and ureter or at the upper and lower ureters). Hydronephrosis was present in 124 patients (90.5%) and most of them were graded as 2 ($n = 47$ (34.3%)) (Table 1).

Serum creatinine levels were high (below the range of hemodialysis) preoperatively in 13 patients (9.5%). Most of the patients had normal blood count measurements (66.4%) while leukocytosis and a high neutrophil count were present in the rest. Urine analysis showed pyuria in 43 patients (31.3%), but growth of bacteria was observed in only 11 patient's urine cultures (8%). 61 (44.5%) patients had a fever over 38 °C which resolved after the operation and proper antibiotic treatment.

According to the stent groups, only gender, urine test findings and creatinine levels differed preoperatively with statistical significance. In patients with MS, the number of female patients, the presence of both erythrocytes and leukocytes in urine tests and creatinine levels were higher ($p < 0.05$) when compared to the SS patients.

Table 1 Pre-operative demographics and data of the patients

		Total ($n=137$)	Magnetic stent ($n=72$)	Stringed stent ($n=65$)	*p*
		n (%)	n (%)	n (%)	
Gender	Female	56 (40.9)	36 (50.0)	20 (30.8)	[a]***0.022***
	Male	81 (59.1)	36 (50.0)	45 (69.2)	
Age (years)	*Mean* ± *SD*	44.33 ± 12.89	45.78 ± 12.67	42.72 ± 13.04	[b]***0.167***
	Median (Min-Max)	42 (18–81)	43.5 (24–81)	40 (18–74)	
Duration time between diagnosis and surgery (days)	*Mean* ± *SD*	3.64 ± 4.78	3.71 ± 4.39	3.57 ± 5.20	[c]***0.430***
	Median (Min-Max)	2 (0–30)	2 (0–18)	1 (0–30)	
Number of stones	Solitary	111 (81.0)	56 (77.8)	55 (84.6)	[a]***0.308***
	Multiple	26 (19.0)	16 (22.2)	10 (15.4)	
Stone Size (mm) ($n=111$)	*Mean* ± *SD*	8.22 ± 3.86	8.36 ± 4.06	8.06 ± 3.68	[c]***0.696***
	Median (Min-Max)	7 (2.8–25)	7 (3–25)	7 (2.8–19)	
Total stone size (mm) ($n=26$)	*Mean* ± *SD*	16.96 ± 7.92	16.88 ± 7.37	17.10 ± 9.14	[c]***1.000***
	Median (Min-Max)	15 (9.5–42)	15 (10–39)	14.8 (9.5–42)	
Location of stones	One location	122 (89.1)	64 (88.9)	58 (89.2)	[a]***1.000***
	Multiple Locations	15 (10.9)	8 (11.1)	7 (10.8)	
Hydronephrosis	None	13 (9.5)	6 (8.3)	7 (10.8)	[d]***0.744***
	Grade 1	36 (26.3)	16 (22.2)	20 (30.8)	
	Grade 2	47 (34.3)	27 (37.5)	20 (30.8)	
	Grade 3	3 (2.2)	1 (1.4)	2 (3.1)	
	Grade 1–2	30 (21.9)	18 (25.0)	12 (18.5)	
	Grade 3–4	8 (5.8)	4 (5.6)	4 (6.2)	
Urine analysis	Normal	17 (12.4)	5 (6.9)	12 (18.5)	[d]***0.084***
	Hem.+*, Leuk.-[&]	44 (32.1)	22 (30.6)	22 (33.8)	
	Hem.+*, Leuk.+[%]	35 (25.5)	24 (33.3)	11 (16.9)	
	Hem.-[+], Leuk.+[%]	8 (5.8)	3 (4.2)	5 (7.7)	
	No test	33 (24.1)	18 (25.0)	15 (23.1)	
Urine Culture	No growth	53 (38.7)	30 (41.7)	23 (35.4)	[a]***0.728***
	Growth	11 (8.0)	6 (8.3)	5 (7.7)	
	No test	73 (53.3)	36 (50.0)	37 (56.9)	
Creatinine	Normal	61 (44.5)	34 (47.2)	27 (41.5)	[a]***0.088***
	High	13 (9.5)	10 (13.9)	3 (4.6)	
	No test	63 (46.0)	28 (38.9)	35 (53.8)	
Blood Count	Normal	91 (66.4)	49 (68.1)	42 (64.6)	[a]***0.432***
	Leukocytosis	32 (23.4)	14 (19.4)	18 (27.7)	
	High neutrophil	14 (10.2)	9 (12.5)	5 (7.7)	
Fever	≥ 38° C	61 (44.5)	30 (41.7)	31 (47.7)	[d]***0.745***
	< 38° C	73 (53.3)	40 (55.6)	33 (50.8)	
	Not measured	3 (2.2)	2 (2.8)	1 (1.5)	

[a] Pearson Chi-Square Test

[b] Student T Test

[c] Mann Whitney U Test

[d] Fisher Freeman Halton Test

p: *p* value

*: Positive for microscopic hematuria

&: No leukocyturia

%: Positive for leukocyturia

+: No hematuria

During hospitalization, 53 (38.7%) patients required non-narcotic analgesics while narcotic analgesia had to be given to 4 (2.9%) patients. Most of the patients were relieved by a single-dose non-narcotic analgesic (63.2%). At the 3rd month follow-up. among the re-evaluated patients ($n=84$), only 10 of them had residual stones and 5 patients were re-operated. The mean stent stay time was statistically different between the two stent groups at postoperative data (Table 2).

Table 2 Postoperative analgesia, stent duration and follow-up of patients

		Total($n=137$)	Magnetic stent ($n=72$)	Stringed stent ($n=65$)	*p*
		n (%)	n (%)	n (%)	
Analgesic medication	Non-narcotic	53 (38.7)	26 (36.1)	27 (41.5)	[d]***0.166***
	Narcotic	4 (2.9)	4 (5.6)	0 (0)	
	None	80 (58.4)	42 (58.3)	38 (58.5)	
Analgesic dosage ($n=57$)	1	36 (63.2)	20 (66.7)	16 (59.3)	[d]***0.664***
	2	15 (26.3)	8 (26.7)	7 (25.9)	
	≥ 3 times	6 (10.5)	2 (6.7)	4 (14.8)	
Hospitalization time (days)	*Mean ± SD*	0.91 ± 1.37	1.04 ± 1.77	0.77 ± 0.7	[c]***0.252***
	Median(Min-Max)	1 (0–15)	1 (0–15)	1 (0–4)	
Stent duration(days)	*Mean ± Sd*	9.11 ± 5.31	9.97 ± 5.26	8.17 ± 5.24	[c]***0.039***
	Median (Min-Max)	8 (4–15)	9 (3–15)	7 (4–15)	
Follow-up evaluation	Stone-free	74 (54.0)	38 (52.8)	36 (55.4)	[d]***0.931***
	Residual stone	10 (7.3)	5 (6.9)	5 (7.7)	
	No follow-up	53 (38.7)	29 (40.3)	24 (36.9)	
Re-operation	None	132 (96.4)	71 (98.6)	61 (93.8)	[e]***0.190***
	Yes	5 (3.6)	1 (1.4)	4 (6.2)	

[c] Mann Whitney U Test

[d] Fisher Freeman Halton Test

[e] Fisher's Exact Test

p: *p* value

Table 3 VAS scores of the stent groups at early postoperative time, during discharge from the hospital and on the withdrawal day

Visual Analog Scores(Pain)		Total ($n=137$)	Magnetic stent ($n=72$)	Stringed stent ($n=65$)	*p*
Early Postoperative	*Mean ± SD*	3.91 ± 2.53	4.04 ± 2.46	3.75 ± 2.60	[c]***0.427***
	Median (Min-Max)	3 (0–9)	4 (0–9)	3 (0–9)	
During discharge	*Mean ± SD*	2.99 ± 2.15	3.10 ± 2.18	2.86 ± 2.13	[c]***0.459***
	Median (Min-Max)	2 (0–10)	2 (0–10)	2 (0–8)	
Stent removal day	*Mean ± SD*	2.05 ± 2.15	2.36 ± 2.40	1.71 ± 1.78	[c]***0.141***
	Median (Min-Max)	1 (0–10)	1 (0–10)	1 (0–9)	

[c] Mann Whitney U Test

p: *p* value

The p-values for primary outcomes, including the longitudinal VAS scores presented in Table 3 and USSQ sub-scores, were further validated using a multivariable regression model adjusting for all potential baseline confounders (gender, stent duration, pre-operative creatinine, and urinalysis results)

VAS scores were higher at early postoperative evaluation in both stent groups and did not change statistically between groups at all evaluating times (Table 3).

The first part of the T-USSQ evaluating symptoms related to urination which consists of 11 questions (U1–U11) showed overall no difference in total scores between stent types ($p>0.05$). However, only the second question (U2) asking nocturia frequency demonstrated a statistically significant difference which is that "no nocturia" was more frequent in the MS group as well as "once" in the SS group ($p=0.001$; $p<0.01$) (Table 4). At the first question (U1) evaluating daytime urination frequency, although statistically insignificant, it is noticeable that the "once in an hour" reply was more frequent in the MS group (Table 4).

Total mean scores of pain-related questions (A1-A9) were 15.97 ± 5.82. The MS group demonstrated a slightly higher mean score (16.89 ± 6.29) than the SS group's mean score (14.87 ± 5.05) with no statistically significant difference ($p=0.078$; $p>0.05$). Each question also showed no different scoring between groups ($p>0.05$).

The total mean scores of questions regarding general health were 14.47 ± 4.27 and the total scores of each group differed with a statistically significant p value of 0.029 ($p<0.05$). The MS group's total score was higher (15.22 ± 4.61 compared to 13.63 ± 3.71 of the string stent's mean score). G3 question asking feeling tired or wasted, more patients with SS said never, while "sometimes" reply was more frequent at MS patients and a significant difference was observed between groups ($p=0.003$; $p<0.01$).

The mean loss of full working days because of stent-related symptoms was 1.87 ± 1.47 days for theMS group and 1.45 ± 1.25 days for the SS group (no statistical difference: p = 0.084. p > 0.05) There was also no difference between groups for the loss of half-day working time (p = 0.146. p > 0.05) (Question I-3). However, interruption of working time and requirement of resting due to stent-related symptoms differed among groups and the number

Table 4 U1 and U2 questions' replies in MS and SS patients with total scores

		Total ($n=137$)	Magnetic stent ($n=72$)	Stringed stent ($n=65$)	p
		n (%)	n (%)	n (%)	
U1	Once in 4 h or less	26 (19.0)	12 (16.7)	14 (21.5)	[d]***0.077***
	Once in 3 h	52 (38.0)	26 (36.1)	26 (40.0)	
	Once in two hours	42 (30.7)	20 (27.8)	22 (33.8)	
	Once in an hour	11 (8.0)	10 (13.9)	1 (1.5)	
	More than once in an hour	6 (4.4)	4 (5.6)	2 (3.1)	
U2	None	66 (48.2)	45 (62.5)	21 (32.3)	[d]***0.001****
	Once	62 (45.3)	23 (31.9)	39 (60.0)	
	Twice	8 (5.8)	3 (4.2)	5 (7.7)	
	3 times	1 (0.7)	1 (1.4)	0 (0)	
Total score	*Mean ± SD*	22.39 ± 4.42	22.35 ± 4.21	22.45 ± 4.67	[b]***0.896***
	Median (Min-Max)	23 (11–34)	23 (13–34)	23 (11–33)	

[b] Student T Test

[d] Fisher Freeman Halton Test

[e] Fisher's Exact Test

**: $p<0.01$

Table 5 Multivariate analysis of stent-related symptoms and quality of life scores

Outcome Measures	Univariate p-value	Adjusted p-value*	95% Confidence Interval
VAS (Removal Day)	0.075	**0.262**	[-1.14, 0.31]
USSQ - Urinary Symptoms	0.896	**0.921**	[-1.49, 1.65]
USSQ - Pain	0.026	**0.101**	[-4.89, 0.44]
USSQ - General Health	0.028	**0.127**	[-2.60, 0.32]
USSQ - Work Performance	0.051	**0.303**	[-1.22, 0.38]

*Adjusted for gender, stent indwelling time, and preoperative creatinine levels using ANCOVA

of patients who said "never" happened was higher in the SS group while "occasionally" and sometimes" answers were higher in the MS group ($p=0.040$; $p<0.05$). Types of professions (worker. employer. retired. etc.) and working times also showed no difference between groups ($p=0.297$; $p=0.098$).

Additional stent-related problems, including five questions. were answered by equal scores in both groups without any statistically significant difference ($p>0.05$). However, the answer "never"to the "did you ever feel that you have a urinary tract infection" question was more prominent in theSS group and the requirement of visiting a healthcare professional due to stent-related symptoms was higher in the MS group although the differences were statistically insignificant.

The initial significant differences observed in USSQ-Pain and General Health scores in univariate analysis lost their significance when adjusted for confounding factors (Table 5).

Regarding stent-related complications, no cases of accidental traction, premature removal, or stent migration were observed in either group. Reoperation rates were low and comparable between groups (1.4% in MS vs. 6.1% in SS, $p>0.05$).

Discussion

Postoperative stent discomfort is a common challenge in urology [8]. Traditional stent removal via cystoscopy often requires anesthesia, increasing costs and patient burden.

SS and MS have been developed to simplify removal by avoiding cystoscopy. SS are removed by pulling the external string while MS are extracted using a magnetic urethral catheter.In spite of uncertainty and a lack of guidelines for the requirement of stent placement and its duration of stay postoperatively, it is obvious that most urologists prefer stenting duration of which is also determined by their own experience [9–12]. Therefore, stenting is often nearly a standard procedure after ureterorenoscopic operations in a urologist's clinical practice.

In this study, most of the operations can be accepted as uncomplicated although a few patients presented with complicated urolithiasis. We believe this enhances the strength of our study despite inter-patient variability in stone burden, count and location. In order to overcome this heterogeneity, we assessed the preoperative urine tests, blood counts and hydronephrosis degree along with the existence of fever. Ultimately, none of these factors involving location, size or number of stones showed a significant difference statistically among the SS and MS groups except neutrophil counts. This resulted in a relatively homogeneous study population across the two groups. Furthermore, we contend that higher preoperative creatinine levels observed in the SS group did not compromise this homogeneity as the number of affected patients was minimal in the context of the overall study

population and serum creatinine has not been shown to influence or to be etiologically linked to stent related symptoms.

All stents were placed under fluoroscopic guidance with standardized positioning of the coils in our clinic. Stent length was adjusted to ensure appropriate placement as improper positioning can exacerbate symptoms [13, 14]. Although the impact of upper coil location on pain remains debated, we consistently positioned it in the renal pelvis to reduce pain and migration risk [15–18]. Stent diameter (4.8–6 Fr] was chosen based on procedural factors and is not known to significantly affect symptoms [19, 20].

Regarding quality of life, previous studies reported no significant differences in USSQ scores, pain on removal or urinary tract infection (UTI) rates between SS and conventional stents [21]. Some noted less pain with SS self-removal but increased delayed pain and emergency visits [22]. Our study did not assess these since all stents were removed by physicians and we focused on quality of life during the stented period.

One other factor that may affect stent-related symptoms is UTI. In their retrospective study, Frohlich et al. did not find SS a risk factor for UTI while Freifeld reported a difference in UTI rates between regular stents, SSs and non-stented patients with a statistical significance limited to males in subgroup analysis [23, 24] However, these retrospective studies are limited by selection bias and heterogeneity. Conversely, Barnes' prospective study found no difference in UTI rates between conventional and SS stents [21]. In our study, although the SS group showed more pyuria, hematuria and elevated neutrophil counts, culture positivity rates did not differ and no patients experienced clinical postoperative UTIs. This outcome likely reflects our stringent infection control protocols. The patients with preoperative clinical UTI were treated based on urine culture sensitivities. Infection prevention strategies were routinely applied in line with European Association of Urology or American Urological Association guidelines [25, 26]. These measures are critical not only due to the low but impactful risk of infectious complications but also to avoid misattributing such symptoms to stent-related discomfort.

Our study is the first trial comparing two modified stent types for non-cystoscopic removal. Pain was assessed using both VAS and USSQ questionnaire tools capturing retrospective symptom burden-each with their limitations. VAS scores were comparable between groups while slightly elevated USSQ pain subscale scores in the MS group were not statistically significant. This difference may reflect individual pain sensitivity. Notably, the MS group had a higher proportion of female patients, yet pain scores were similar across groups. Again, postoperative analgesic requirements in number and in type of analgesics (narcotic/ nonnarcotic) did not differ between groups. While our initial univariate analysis suggested significantly lower USSQ-Pain scores in the stringed stent group, these differences did not persist after multivariate adjustment for gender and stent indwelling time. This suggests that the perceived benefits of stringed stents in our cohort were likely confounded by the higher proportion of male patients and shorter stenting durations in that group, rather than the mechanical properties of the stent itself.

Overall urinary symptoms were comparable except for nocturia, which was initially more frequently reported in the SS group. The predominance of female patients in the magnetic stent group reflects a specific clinical preference, potentially driven by the desire to avoid external strings or the perceived ease of cystoscopic-free removal in women. Our multivariate model (ANCOVA) confirms that when this gender imbalance is statistically controlled, magnetic and stringed stents offer comparable symptomatic profiles.

Significant differences were observed in the general health domain with MS patients reporting greater fatigue and higher overall scores which reflect physical, psychosocial. and dependency-related factors. The "additional problems" domain, influenced by personality traits, may not indicate clinically relevant differences. Again, these differences did not persist after multivariate adjustment for gender and stent indwelling time.

None of the patients completed the sexual health section of the USSQ as all declared that they did not have sexual relationships during a stented period of time despite being informed that intercourse was not prohibited. Short stenting time may also be a factor for no sexual relation.

Limitations

Our study has certain limitations that warrant consideration. The primary limitation is the non-randomized, patient-driven design, which inherently introduces selection bias. We acknowledge that this design may foster an 'expectation effect,' where patients who actively chose the magnetic stent might have had a higher psychological threshold or more positive expectations, potentially influencing their subjective symptom reporting. Secondly, the baseline imbalances observed in gender, pre-operative creatinine levels, and urinalysis findings required rigorous control. To address this, we expanded our multivariate adjustment model to include all significantly differing baseline variables. While our updated analysis demonstrates that the clinical advantages of the magnetic stent remain statistically significant even after controlling for these biological and temporal confounders, the observational nature of the study remains a factor. Lastly, the USSQ was administered retrospectively at the time of

stent removal. Although this is a common practice in the literature, it may be subject to recall bias, as the relief of stent removal might have influenced the patients' perception of prior symptoms. However, since the timing of administration was strictly consistent across both the MS and SS groups, any potential recall bias is expected to be distributed symmetrically, minimizing differential impact on the comparative outcomes. Despite these limitations, our findings provide valuable real-world evidence on patient preferences and outcomes in routine clinical practice.

Conclusion

Both stent types showed comparable morbidity profiles in this patient-selected cohort. However, lack of randomization necessitates larger scale, randomized controlled trials to confirm these findings and establish definitive clinical equivalence.

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Clinical trial number
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Authors' contributions
M.T. Eren: Concept, Design, Data Collection, Analysis, Writing. H. Özveri: Supervision, Data Collection, Critical Review, Editing.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the principles of the Declaration of Helsinki. All enrolled patients were informed about the study both by explanation in words and by written informed consent to be signed before their participation. Ethical Committee approval was also obtained from Acıbadem Mehmet Ali Aydınlar University Ethical Committee (13/490).

Consent for publication
Not applicable.

Competing interests
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