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A novel suturing technique for natural tissue repair in cystocele treatment

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Abstract

Background Recently, natural tissue repair has become popular in the treatment of pelvic organ prolapsed. In this study, we compared patients who underwent cystocele repair with the rug-weaving plication technique, a natural tissue repair method implemented since 2022 for anterior prolapse, with those treated using conventional colporrhaphy.

Methods We retrospectively reviewed the data of 65 patients who underwent anterior vaginal wall repair with the rug-weaving plication technique ($n=33$, Group 1) or conventional colporrhaphy ($n=32$, Group 2). We recorded the patients' clinicodemographic and surgical data. At the 6-month postoperative follow-up, we assessed patients' complaints, degree of prolapse (using the simplified Pelvic Organ Prolapse Quantification system), and pelvic floor muscle strength (using the Modified Oxford Score). Anterior vaginal wall thickness was measured using transvaginal ultrasonography. We compared clinicodemographic and surgical data and postoperative outcomes between the two groups.

Results The two groups were comparable in terms of age ($p=0.326$), number of pregnancies ($p=0.307$), number of parities ($p=0.555$), preoperative anterior wall simplified Pelvic Organ Prolapse Quantification grade ($p=0.380$), preoperative apical prolapse simplified Pelvic Organ Prolapse Quantification grade ($p=0.518$), postoperative Modified Oxford Score ($p=0.857$), operation time ($p=0.809$), postoperative haemoglobin ($p=0.674$), and amount of bleeding ($p=0.951$). Compared with Group 2, Group 1 had significantly higher postoperative anterior vaginal wall thickness ($p<0.001$) and significantly lower postoperative anterior wall simplified Pelvic Organ Prolapse Quantification grade ($p<0.001$).

Conclusions The rug-weaving plication technique may offer a viable alternative for cystocele repair without mesh, using natural tissue and potentially reducing mesh-related complications and recurrence rates.

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Keywords Anterior colporrhaphy, Cystocele, Natural tissue repair, Suture technique

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Introduction

Pelvic organ prolapse (POP) is a condition frequently seen in advanced-age women [1]. POP significantly impairs women's quality of life. The need for surgical intervention increases with the grade of POP; approximately 11–20% of women with POP are estimated to require surgical repair [2–5].

The literature reports that nearly one in five women will require surgery in their lifetime because POP and nearly 40.6% involve anterior wall repair, specifically cystocele [6]. Cystocele is a defect of the anterior compartment of the vaginal wall, often necessitating anterior colporrhaphy as the primary surgical intervention. Cystocele manifests as a central defect involving the weakness of the pubocervical fascia, a lateral defect presenting with the lateral weakness in the paravaginal region, as part of apical prolapse, or a combination of these. While conservative treatment options are available, most patients are treated surgically [7]. Cystocele surgery primarily aims to strengthen the weak tissues through plication and approximation of lateral tissues. However, conventional anterior colporrhaphy yields limited success, with reported recurrence rates of 30–70% [8], prompting surgeons to explore new surgical techniques. Surgical techniques can involve natural tissue repair using only pelvic organ tissue support or augmented repair employing prostheses or synthetic materials known as grafts [7].

Over the past decade, the widespread use of transvaginal mesh for anterior vaginal wall repair, coupled with its perceived long-term effectiveness, has overshadowed native tissue repair methods [9]. Numerous observational studies have reported that mesh-based surgeries have better recurrence rates than traditional native tissue repair methods [10, 11], leading to the widespread utilisation of mesh-based surgical techniques. However, recent concerns regarding mesh-related complications [12] have prompted regulatory action, with the Food and Drug Administration (FDA) categorising mesh-associated risks as moderate or high [13]. The consequent decline in mesh utilisation [14] has prompted a resurgence of interest in native tissue repair methods, with an increasing number of studies focusing on surgical techniques that reduce the high recurrence rates associated with native tissue repair.

In this study, we compared patients who underwent surgery using the rug-weaving plication technique, a natural tissue repair method we have been employing since 2022 for anterior prolapse, with those who underwent surgery using conventional techniques.

Methods

This was a retrospective study conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Ankara Bilkent City Hospital Clinical Research Ethics Committee (27.09.2023-Etical No:

E2-23-5039), which waived the need for informed consent because of the study's retrospective design. We included 65 patients who underwent surgery solely for cystocele or cystocel with other organ prolapse conditions; of them, 33 received the rug-weaving plication technique, a natural tissue repair method implemented for anterior wall defects since 2022, and 32 underwent conventional anterior colporrhaphy. We recorded the patients' clinicodemographic data, including age, preoperative complaints, number of pregnancies, number of deliveries, mode of delivery, comorbidities, medication history, menstrual status, and year of menopause, if applicable. Additionally, the anterior vaginal wall, the posterior vaginal wall, and apical prolapse were assessed according to the simplified Pelvic Organ Prolapse Quantification (S-POP-Q) grading system [15]. Preoperative and postoperative haemoglobin levels, complications, operation duration, and bleeding volume were documented. At the 6-month postoperative follow-up examination, we noted the patients' postoperative complaints; degree of prolapse evaluated using the S-POP-Q system and pelvic floor muscle strength by using Modified Oxford Score (MOS) [16]. Anterior vaginal wall thickness between the bladder and anterior vaginal wall was measured using transvaginal ultrasonography (Voluson-VSX800870510/F-709879, Korea) and recorded in millimetres.

The POP-Q staging system was introduced in 1996 and widely accepted as the standard quantitative classification system for POP [17]. The S-POP-Q was validated against the POP-Q and found to be highly correlated. Instead of nine points, the S-POP-Q system has four points consisting of the anterior wall, posterior wall, cervix, and posterior fornix were defined. Prolapse is classified as grade 1–4 according to the distance of the four points to the hymen (15). In this study, prolapse was classified according to the S-POP-Q system.

Surgical technique

All surgeries were conducted under general or spinal anaesthesia with the patient in the lithotomy position. Prior to commencing the operation, the labia were sutured to the sides to facilitate visualisation, and defect areas were identified one by one by using the S-POP-Q system. We used a modified version of the rug-weave suturing technique, originally described by Dr. Findik and coworkers for closing pericardial defects [18]. The procedure commenced with dissection, with the bladder full. A vaginal incision was made for cystocele repair, with dissection continuing until approximately 1.5–2 cm centrally to the urethral meatus. For patients undergoing vaginal hysterectomy, the dissection was extended up to the vaginal cuff, while for those with a preserved uterus, it proceeded until the cervix–bladder line. Lateral

dissection involved dissecting the pubocervical fascia until the arcus tendineus fascia pelvis (ATFP) was on both sides. Suturing commenced through the ATFP on the left side, progressing from top to bottom and then from bottom to top along the pubocervical fascia, reaching the right ATFP. Following this, bladder integrity was confirmed by checking the presence of bloody urine, and the sutures passing through both ATFPs were tied at the midpoint by using 2–0 polyglactin sutures while the bladder was repositioned under the symphysis pubis by an assistant. After dissection, the excess vaginal mucosa was excised, and the mucosa was sutured using 3–0 polyglactin sutures (Figs. 1 and 2).

Patients in Group 2 underwent classical anterior colporrhaphy by using 2–0 polyglactin sutures. Preoperative prophylactic antibiotics (ceftriaxone 1 g intravenous infusion, clindamycin 900 mg of intravenous infusion for beta-lactamase-reactive patients) were administered to all patients. Some patients underwent additional prolapse surgery for concurrent defects alongside cystocele repair.

Statistical analysis

Data entry and analysis were performed using SPSS, version 21.0 (IBM, Armonk, NY). Between-group comparisons were performed using the chi-square test,

Mann–Whitney U test, independent simple test, and Wilcoxon signed-ranks test. The chi-square test was employed to compare categorical variables, and the Mann–Whitney U test was used to compare nonnormally distributed continuous variables. The independent simple test was utilised to assess the significance of differences between the means of continuous variables between the two groups. The Wilcoxon signed-ranks test was applied to evaluate the relationship between preoperative–postoperative anterior vaginal wall S-POP-Q grade and preoperative–postoperative haemoglobin. Spearman's rho correlation test was also used to evaluate the relationship between postoperative MOS and postoperative anterior wall S-POP-Q grade. $p \leq 0.05$ was accepted as significant.

Results

Group 1 comprised 33 patients who underwent the rug-weaving plication technique, whereas Group 2 comprised 32 patients who underwent the standard anterior colporrhaphy.

No significant between-group differences were observed in the presence of comorbidity ($p=0.813$), mode of delivery ($p=0.238$), medication use ($p>0.99$), preoperative complaint (all patients complained of swelling), postoperative complaint (none of the patients

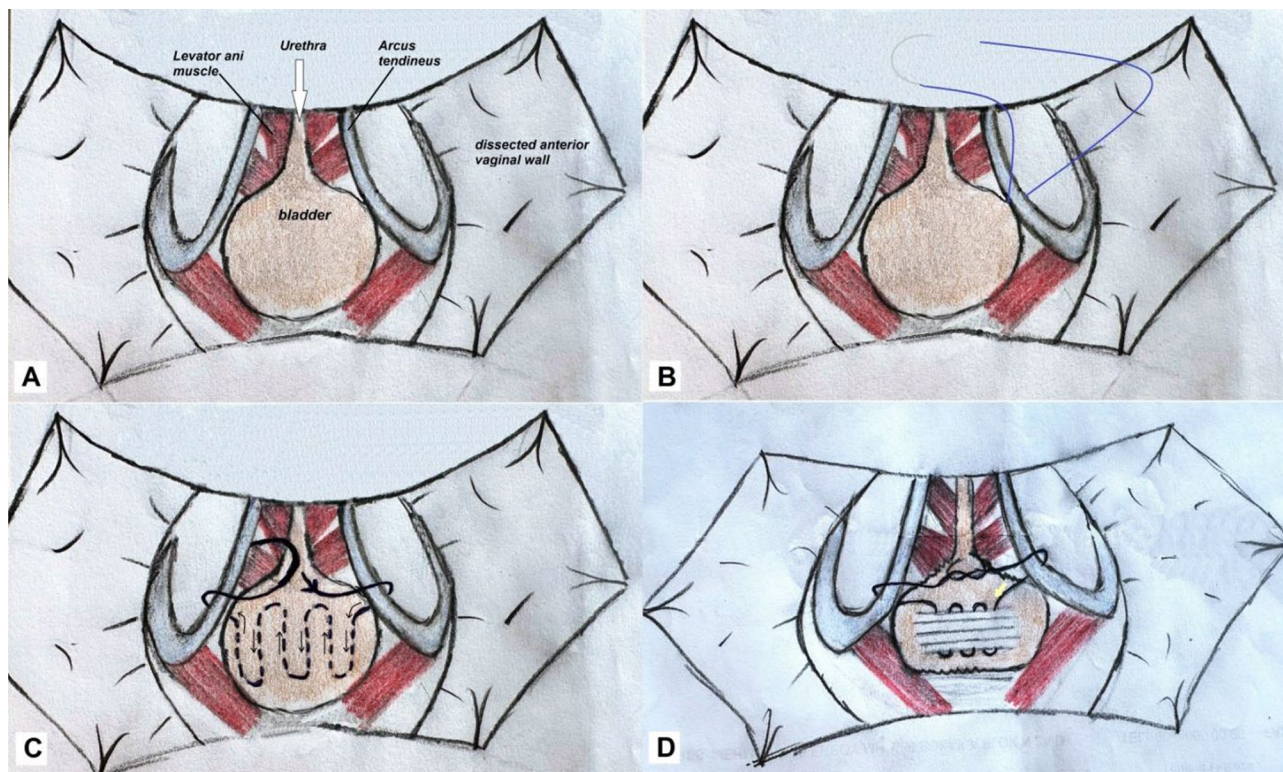


Fig. 1 Schematic representation of suture technique. **A.** Appearance of the bladder and ATFP(arcus tendineus fascia pelvis) after anterior vaginal wall dissection. **B.** Schematic view of passing the first suture through the left ATFP. **C.** Schematic view of the repair of pubocervical defects, showing transitions from top left to bottom and from bottom to top. **D.** Finally, the bladder is emptied by placing a suture through the right ATFP. An assistant helps push the bladder under the symphysis pubis, and the suture is then tied in the middle

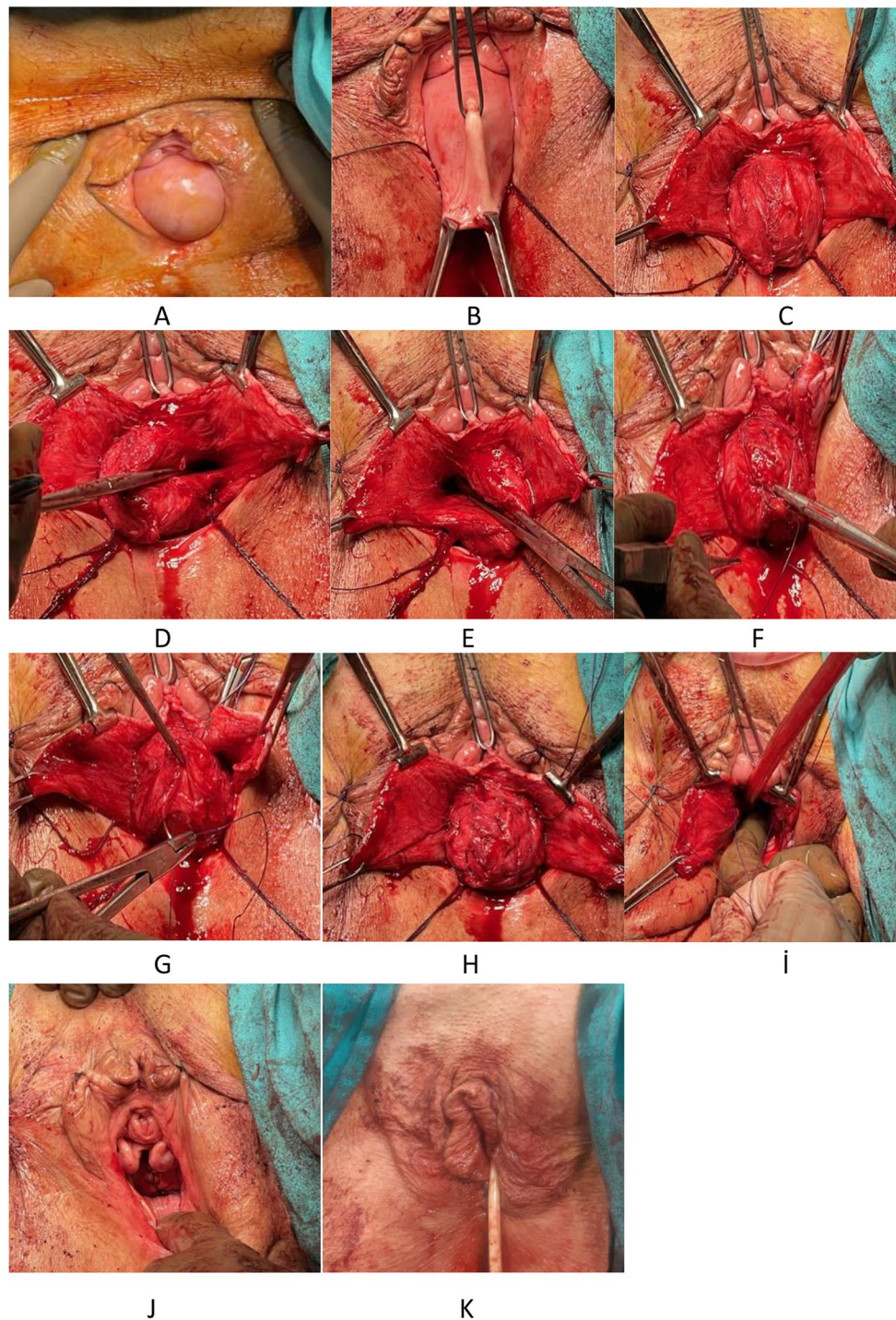


Fig. 2 Photo images of the operation stages, from beginning to end. **A.** The first image is taken with the patient in the lithotomy position at the beginning of the operation. **B.** Dissection view of the anterior vaginal wall extending up to 1.5–2 cm below the urethra in the central area. **C.** Pubocervical fascia and bladder image after dissection. **D.** Dissection image extending to the left ATFP. **E.** Dissection image extending to the right ATFP. **F.** Suturing of the pubocervical fascia with needle passes from top to bottom after passing through the left ATFP. **G.** Suturing the pubocervical fascia with needle passes from bottom to top. **H.** Image showing the sutures after the needle has passed through the pubocervical fascia. **I.** After the bladder is emptied and repositioned, the sutures are tied in the middle. **J.** Image after suturing the anterior vaginal wall mucosa. **K.** The final image of the operation

complained of swelling), type of operation (anterior colporrhaphy alone or with an additional operation; $p=0.427$), age ($p=0.326$), number of pregnancies ($p=0.307$), number of parities ($p=0.555$), preoperative anterior wall S-POP-Q grade ($p=0.380$), preoperative apical prolapse S-POP-Q grade ($p=0.518$), postoperative MOS ($p=0.857$), operation time ($p=0.809$), postoperative haemoglobin values ($p=0.674$), and amount of bleeding ($p=0.951$) (Table 1).

The preoperative posterior wall S-POP-Q grade was higher in Group 2 ($p=0.032$), whereas preoperative haemoglobin values were higher in Group 1 ($p=0.039$). Furthermore, compared with Group 2, Group 1 had significantly higher postoperative anterior vaginal wall thickness ($p<0.001$) and significantly lower postoperative anterior wall S-POP-Q grade ($p<0.001$). Additionally, menopause duration was significantly higher in Group 2 ($p=0.05$).

A significant correlation was observed between preoperative and postoperative haemoglobin values in both groups, with postoperative haemoglobin being significantly lower than preoperative haemoglobin in both

groups ($p<0.001$ and coefficient: $-4,442$ for Group 1; $p<0.001$ and coefficient: $-3,647$ for Group 2). Additionally, the postoperative S-POP-Q grade was significantly reduced compared with preoperative values in both groups ($p<0.001$ and coefficient: $-4,989$ for Group 1; $p<0.001$ and coefficient: $-3,812$ for Group 2) (Table 2).

A moderate negative correlation was observed between MOS and postoperative anterior wall S-POP-Q grade in Group 2, indicating that as MOS decreased, the postoperative anterior wall S-POP-Q grade increased ($p=0,001$ and coefficient: $-,540$). In Group 1, a weak negative correlation was noted, and low MOS did not significantly affect the S-POP-Q grade ($p=0,229$ and coefficient: $-0,215$) (Table 3).

Discussion

Cystocele, a condition augmented by advancing age, can be managed conservatively or surgically depending on the severity of prolapse and patient preferences [1]. While the classical anterior colporrhaphy remains a popular choice, its frequent postoperative recurrences have driven surgeons to explore more successful approaches,

Table 1 Table comparing two groups

		Group 1(n=33)	Group 2(n=32)	P values
Age		59,09±7,8	61,53±11,6	0,326
Number of pregnancies		3,45±1,48	3,69±1,25	0,307
Number of parities		3,06±1,19	3,19±1,2	0,555
Menopause duration (year)		10,24±7,16	14,6±10,28	0,050
Preoperative anterior wall S-POP-Q grade		2,8±0,39	2,89±0,35	0,380
Preoperative posterior wall S-POP-Q grade		0,64±0,92	1,28±1,25	0,032
Preoperative apical prolapse S-POP-Q grade		1,93±1,19	2,14±1,21	0,518
Preop Hb		13,3±1,67	12,06±1,13	0,039
Type of operation:	CA only	5	2	
	CA+add.op.	28	30	0,427
Medication use:	No	8	7	
	Yes	25	25	$p>0,99$
Presence of comorbidity:	No	8	6	
	Yes	25	26	0,813
Mode of delivery	NVD	33	30	
	C/S	0	2	0,238
Postoperative anterior wall S-POP-Q grade		0,57±0,8	2±1	$p<0,001$
Postoperative MOS		1,2±0,76	1,12±0,6	0,857
Postoperative anterior vaginal wall thickness (mm)		7,7±1,7	5±1,2	$p<0,001$
Postop Hb		11,9±1,25	11,6±2,2	0,674
Amount of bleeding (cc)		61,2±28,6	62,5±23,8	0,951
Operation time(hour)		1,77±0,63	1,73±0,7	0,809

NVD: Normal vaginal delivery

C/S: Caesarian /Sectio

CA: Colporrhaphy anterior

CA+add.op.: Colporrhaphy anterior+additional operation

MOS: Modified Oxford Score

Postop Hb: Postoperative haemoglobin values

Preop Hb: Preoperative haemoglobin values

Statistically significant data are highlighted in bold

Table 2 Comparison of two groups with Wilcoxon signed Ranks Test

Groups		Postoperative anterior wall S-POP-Q/ Preoperative anterior wall S-POP-Q	Postop Hb/ Preop Hb
1	Z	-4,989 ^b	-4,442 ^b
	Asymp. Sig. (2-tailed)	0,000	0,000
2	Z	-3,812 ^b	-3,647 ^b
	Asymp. Sig. (2-tailed)	0,000	0,000

a. Wilcoxon Signed

Ranks Test

b. Based on positive ranks

S-POP-Q: simplified Pelvic Organ Prolapse Quantification

Postop Hb: Postoperative haemoglobin values

Preop Hb: Preoperative haemoglobin values

including mesh repair methods, which are developed through biotechnological advancements and have offered promising outcomes [19]. Despite studies reporting surgical mesh repair as safe and cost effective [20], FDA's 2011 warning regarding mesh complications [13] prompted comparative studies with traditional methods [1]. They revealed lower recurrence rates but increased complications associated with mesh usage, such as pain and infection [21–25]. These uncertainties in surgical treatment have increased the consideration of nonsurgical approaches, including pelvic floor exercises and pessaries, particularly among older women. The determination of surgical or nonsurgical interventions is guided by an assessment of a woman's functional capacity and risk status [26].

Recent years have seen an increased emphasis on native tissue repair, and surgeons have explored various

mesh-free surgical techniques in anterior vaginal repair [7, 9, 19], aiming to mitigate the recurrence and complications associated with conventional mesh-free native tissue repair. Advances in anatomical understanding, surgical fundamentals, and clinical research have enhanced native tissue repair procedures [27].

In this study, we used polyglactin sutures with the rug-weaving plication technique for mesh-free native tissue repair. In the plication technique we use, the needle is first passed through the left arcus tendineus fascia pelvis (ATFP). Next, the needle is inserted through the pubocervical fascia, initially from top to bottom and then from bottom to top. After traversing the entire pubocervical fascia, the needle is passed through the right ATFP. Finally, after the bladder is emptied, the suture passing through the two ATFPs is tied in the middle. This approach repairs all pubocervical fascia defects and secures them to both the right and left ATFP. Our technique achieves both paravaginal repair and pubocervical fascia plication (Fig. 1).

In our hospital, we used polyglactin sutures for both classical anterior colporrhaphy and our operations employing the plication technique. This ensured standardisation of the suture factor across patient groups using different methods.

At the 6-month postoperative follow-up, the anterior wall S-POP-Q grade was significantly lower among patients treated with our rug-weaving plication technique (Group 1), whereas those treated with classical anterior colporrhaphy (Group 2) exhibited significantly higher anterior wall S-POP-Q grades. However, the preoperative complaint of swelling, present in all patients, was alleviated postoperatively in both groups. Despite the similarity of both groups in factors potentially impacting

Table 3 Relationship table between MOS and postoperative anterior wall S-POP-Q grade

Spearman's rho	gr	MOS	Postoperative anterior wall S-POP-Q grade
1	MOS	Correlation Coefficient	1,000 -0,215
		Sig. (2-tailed)	0,229
		N	33 33
	Postoperative anterior wall S-POP-Q grade	Correlation Coefficient	0,215 33
		Sig. (2-tailed)	0,229
		N	33 33
2	MOS	Correlation Coefficient	1,000 -,540**
		Sig. (2-tailed)	0,001
		N	32 32
	Postoperative anterior wall S-POP-Q grade	Correlation Coefficient	,540** 1,000
		Sig. (2-tailed)	0,001
		N	32 32

** Correlation is significant at the 0.01 level (2-tailed)

MOS: Modified Oxford Score

S-POP-Q: simplified Pelvic Organ Prolapse Quantification

prolapse, the variance in surgical technique suggests the effectiveness of our approach.

Notably, the operation time and bleeding volume were comparable across both groups, despite the application of different surgical techniques. The higher decrease in haemoglobin levels in Group 1 could be attributed to the deeper paravaginal dissection required than that in the classical method.

Although menopause duration was significantly different between Groups 1 and 2, we believe its impact on our results is limited, as the *p* value is borderline.

Moreover, postoperative anterior vaginal wall thickness was notably thicker in Group 2 than in Group 1, affirming the analogy of “mesh made of natural tissue” associated with this technique.

None of our patients in either group received non-surgical prolapse treatment preoperatively or postoperatively, ensuring that factors potentially affecting treatment outcomes were standardized.

It is well-established that pelvic floor weakness is one of the most common causes of pelvic organ prolapse (POP) [28]. In our study, we also assessed pelvic floor muscle strength at the 6th postoperative month using the MOS. Our study included patients who had not previously undergone pelvic floor muscle exercise programs or physical therapy. We observed no significant difference between the postoperative MOS values of these groups. However, when examining the relationship between MOS values and postoperative anterior wall S-POP-Q values within each group, we found that low MOS values in patients who underwent surgery with the plication technique did not result in an increase in S-POP-Q grade. In contrast, low MOS values in patients who underwent surgery with the classical technique were associated with an increased S-POP-Q grade. Correlation analysis revealed a moderate negative relationship between MOS values and postoperative S-POP-Q grade in the classical technique group. This suggests that low MOS values, indicating pelvic floor muscle weakness, may be associated with an elevation in S-POP-Q grade. Conversely, in the plication group, the negative relationship between MOS values and S-POP-Q grade was not statistically significant, indicating that low MOS did not significantly affect S-POP-Q grade. This finding suggests that the plication technique may offer more successful outcomes in preventing the recurrence of POP compared to the classical technique.

The relatively short follow-up period and the limited number of patients in our study are acknowledged as notable limitations. Additionally, the use of a non-absorbable suture material like prolene instead of polyglactin might have potentially yielded even more successful results. However, given the retrospective nature of

our study, we were limited to compare the outcomes of previously treated patients.

Recent evidence suggests that the surgical technique utilization plays a pivotal role in the outcomes of prolapse repair with natural tissue [28]. Native tissue repair seems to be a milestone in the POP surgery [29] and represents a safe procedure with cost effectiveness and low morbidity rates [30].

Conclusions

In conclusion, our findings suggest that the rug-weaving plication technique may represent a mesh-free approach using natural tissue in cystocele repair, avoiding mesh-related complications and potentially reducing recurrence rates. Future larger-scale prospective studies are warranted to comprehensively investigate this technique.

Abbreviations

S-POP-Q	Simplified Pelvic Organ Prolapse Quantification
MOS	Modified Oxford Score
POP	Pelvic organ prolapse
FDA	Food and Drug Administration
ATFP	Arcus Tendineus Fascia Pelvis

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Author contributions

RBF: Protocol/project development, data collection and management, manuscript writing/editing. MD: Final analysis. OSA: Final analysis. ZYC: Manuscript writing/editing. JK: Statistical analysis.

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Data availability

The datasets generated and/or analyzed during the current study are not publicly available [due to patient confidentiality] but are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was designed as a retrospective research. Given its retrospective nature, informed consent was waived by the ethics committee. Ethical approval was obtained from the Ankara Bilkent City Hospital Clinical Research Ethics Committee in accordance with the Declaration of Helsinki (27.09.2023-Etical No: E2-23-5039).

Consent for publication

No.

Financial interests

The authors declare they have no financial interests.

Competing interests

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