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ORIGINAL RESEARCH

Application of an Intestinal Spatula in Optimizing a Sacrospinous Ligament Suspension

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Objective: The purpose of this study was to investigate the application of an intestinal spatula in a sacrospinous ligament suspension, the effects of this surgical method on the surgical field, and surgical effectiveness.

Methods: The clinical data of 33 patients who underwent suspension using intestinal spatula and 33 patients who underwent traditional surgery were collected, and the duration of surgery, amount of intraoperative blood loss, degree of postoperative pain, and degree of preoperative and postoperative uterine prolapse between the two groups were compared.

Results: Multivariate analysis revealed that the modified technique significantly reduced anal pain incidence (OR=0.17, P=0.015) and improved anatomical C-point recovery (β=−0.73, P<0.001), though no significant differences were observed in operative time or blood loss.

Conclusion: This study revealed that the application of an intestinal spatula in a sacrospinous ligament suspension can improve the surgical effect and reduce the incidence of postoperative complications, which is of clinical significance.

Keywords: intestinal spatula, sacrospinous ligament suspension, surgical field, surgical effectiveness

Introduction

In high-income countries, the number of people requiring surgical treatment for pelvic organ prolapse (POP) will gradually increase over the next decade with aging.[1] With the advent of an aging society in China, improvements in social living standards and the pronatalist policy, the number of POP patients is expected to gradually increase,[2] and this increase is related to risk factors for POP, such as age, multiple parturition, race, body mass index, vaginal delivery, and constipation.[3] Sacrospinous ligament suspension surgery is an effective apical-support surgery, with a subjective cure rate of 70–98% and an objective cure rate of 67–97%.[4,5] For patients with anterior and posterior vaginal wall prolapse, failure to reinforce apex prolapse often increases the rate of surgical failure,[6] and transvaginal sacrospinous ligament fixation has once again aroused people's attention. The sacrospinous ligament was first used as an anchor point in the context of vaginal prolapse and uterine prolapse in 1958. In 1968, Richter promoted it in Europe, and in 1972, Randall and Nichols used this technology in the United States.[7] According to a meta-analysis of the relevant literature, the probabilities of neurovascular injury, urinary retention, urinary tract injury and bladder fistula or rectal fistula in this surgery are approximately 7.4%, 13.4%, 5.6%, and 1.1%, respectively.[7] However, urinary tract injury often occurs during combined bladder prolapse repair surgery.

The sacrospinous ligament suspension is a common treatment method, its surgical effect is affected by the surgical field and surgical effectiveness. In recent years, the intestinal spatula, as a new surgical auxiliary tool, has been introduced into the sacrospinous ligament suspension, which has potential advantages in improving the surgical field and surgical effectiveness. However, systematic research and analysis on the effects of intestinal spatula in sacrospinous ligament suspensions are still lacking. Therefore, this study aimed to investigate the application of the intestinal spatula in sacrospinous ligament suspension and the effect of this surgical method on the surgical field and surgical effectiveness to provide more evidence supporting its use in clinical treatment, and to increase the understanding of POP in primary health units.

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Materials and Methods

The intestinal spatula (Figure 1A) is a 30-cm stainless steel instrument with a 3-cm-wide curved blade. During surgery, it was angled at 30° to retract the rectal wall laterally, creating a triangular working space (Figure 2A). This maneuver increased the operative field compared to traditional retractors. Suturing was performed using a long-type needle holder (12-inch;) (Figure 1B) under direct visualization (Figure 2B). In order to ensure the consistency of the technology, all operations are completed by the same chief physician.

Subjects

We analyzed 66 female patients who underwent vaginal sacrospinous ligament fixation due to uterine prolapse in our hospital between April 2020 and October 2023. All 66 patients had stage III uterine prolapse or higher, with the degree of uterine prolapse classified according to the POP-Q staging system established by Professor Bump in 1996.[8] All 66 patients underwent sacrospinous ligament suspension, 33 of whom used traditional methods such as vaginal retractors and S retractors to expose the surgical field. For 33 patients, an intestinal spatula and S retractor were used to expose the surgical field. None of the patients underwent surgery for urinary incontinence. The exclusion criteria included the presence of other benign and malignant gynecological diseases in addition to prolapse and serious medical diseases, such as heart failure and renal failure.

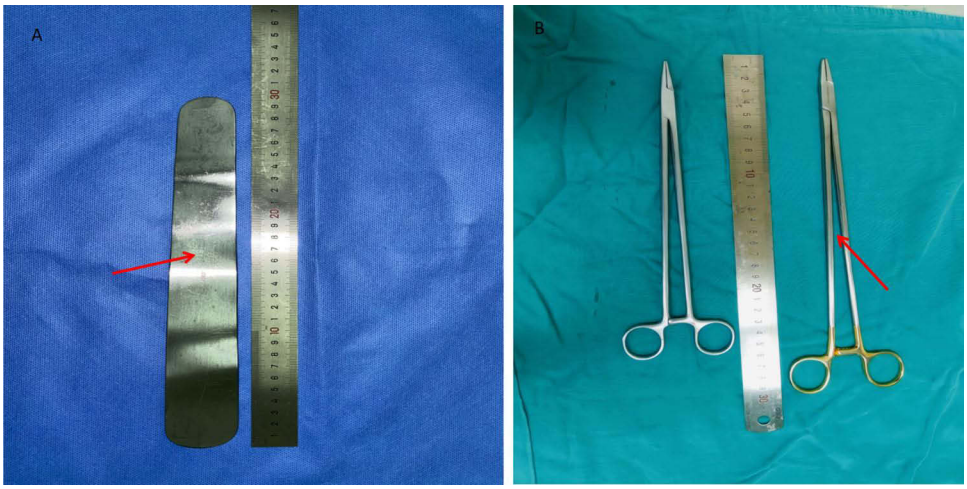

Figure 1 (**A**) Intestinal spatula, measuring 30 cm in length and approximately 3 cm in width, is a standard instrument in surgical setting. Arrow: Intestinal spatula. (**B**) Needle holders, available in lengths of 26 cm and 28 cm, facilitate maneuvers within deeper pelvic cavities. Arrow: Needle holder.

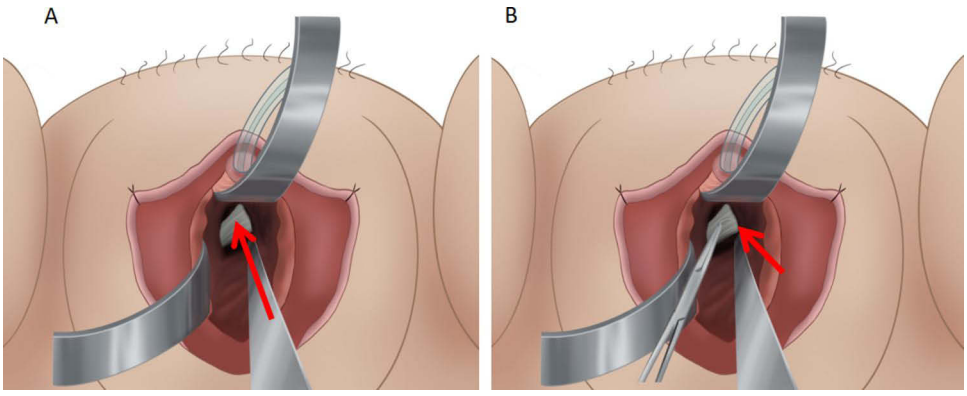

Figure 2 (**A**) By positioning two S-retractors and an intestinal spatula on the lateral aspect of the rectum, a triangular zone is established through external traction to fully expose the sacrotuberous ligament. Arrow: sacrospinous ligament. (**B**) Following exposure of the sacrospinous ligament, suturing is performed at approximately 2 cm from the ischial spine using a 28-cm needle holder directed toward the right acromion. Arrow: sacrospinous ligament.

Preoperative Evaluation

All patients included in the study had complete data, including incidence, past history, reproductive history, physical examination, body mass index, pelvic organ prolapse quantification (POP-Q) score, pelvic floor ultrasound examination, preoperative sexual life satisfaction score, and quality of life score for POP. Malignant gynecological diseases were ruled out, and preoperative vaginal disinfection was performed. The surgery was performed by a physician trained in pelvic floor reconstructive surgery. The right sacrospinous ligament was chosen as the fixation point.

Surgical Procedure

After the application of general anesthesia, the bladder was placed in the lithotomy position, and a sterile drape was applied for catheterization. Water separation of the rectovaginal space: Three tissue forceps were placed at the midline of the posterior vaginal wall to clamp the posterior lip of the cervix, the midsection of the posterior vaginal wall, and the mucous membrane at the vaginal opening, respectively. A 20 mL syringe was used to inject 100 mL of normal saline into the rectovaginal space, and an incision was made longitudinally in the center. The posterior vaginal wall reached 1 cm below the cervix and 2 cm above the hymen. The depth of the incision reached the rectovaginal septum. After the correct rectovaginal space was entered, the "lychee-colored" fascia swollen by water could be observed. The fascia was incised a little, and dissected along this space can reduce surgical bleeding. The assistant used four tissue forceps to clamp the left and right vaginal walls and pulled them in opposite directions, and the right index finger was bluntly dissected laterally to the ischial spine. Dissection and exposure of the sacrospinous ligament: After the ischial spine was palpable, the right index finger was bluntly dissected up and down in the direction away from the rectum. At this time, the sacrospinous ligament was palpable with the right index finger inside the ischial spine. The intestinal spatula was placed parallel to the rectum and placed at the upper right of the rectum; the large S retractor was placed under the right posterior vaginal wall and parallel to the levator ani muscle to the ischial spine; the small S retractor was placed under the vaginal wall made of an incision in the posterior cervix. If the display is not clear to the naked eye, the right index finger can be used to touch the ligament again, or the tissue forceps can be used to indicate if necessary. Suturing of the sacrospinous ligament: A 1/0 non-absorbable suture was used at sacrospinous ligament at a distance of 2 cm from the ischial spine with a depth of 3–5 mm. To prevent the single needle from being weakened, a second stitch can be sutured on the medial side of this location, and the suture can be pulled hard or suture fixation which means that the anchor point was on the sacrospinous ligament, and the other end of the suture was fixed at the posterior and lower parts of the cervix. If the uterus was removed, it was sutured at the apex of the vaginal stump. There was no active bleeding, and the suture did not penetrate the rectum during the rectal examination. The vaginal wall was sutured: the non-absorbable suture for sacrospinous ligament was closed with a knot, and the vaginal wall was sutured with 2/0 absorbable suture (Figure 3).

Postoperative Follow-Up

The patients were followed up at the hospital 1 month, 3 months, and 6 months after the surgery, and every year thereafter. The POPQ score, postoperative sexual life satisfaction questionnaire and pelvic floor dysfunction questionnaire (PFDI-20) were used for comparisons of the subjective and objective recovery status after surgery. The assessment of surgical complications was based on the recent records of case data and the assessment of long-term complications during the postoperative follow-up.

Results

General Data

This study included 33 patients who received suspension using intestinal spatula and 33 patients who received traditional surgery. The baseline characteristics of the patients in the two groups are shown in Table 1. Independent samples t tests and Mann–Whitney tests revealed significant differences in age and preoperative PFDI-20 scores between the two groups of patients, which may be among the factors influencing the results; the remaining data of the patients were not significantly different between the two groups.

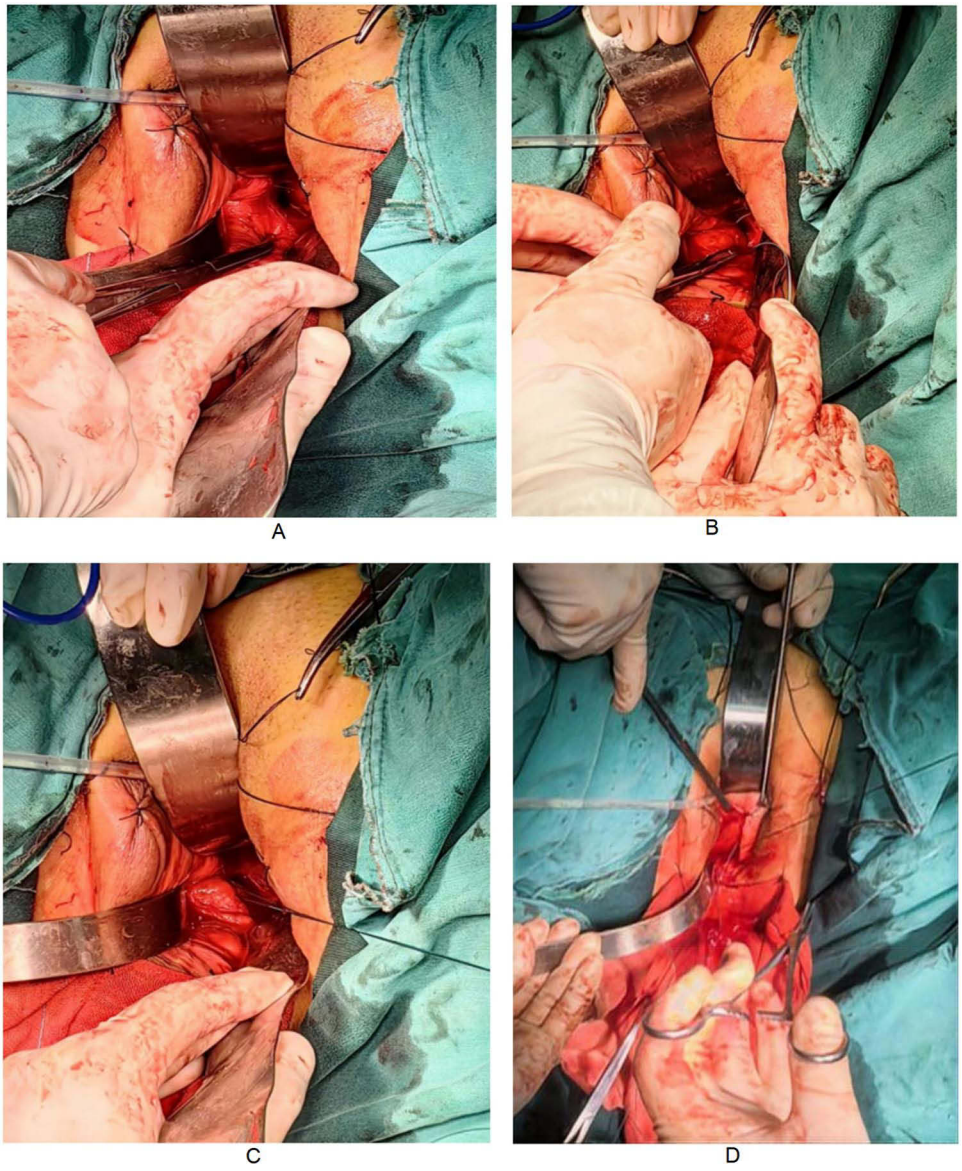

Figure 3 Techniques of Using an Intestinal Compressor to Expose the Surgical Field during Sacrospinous Ligament Fixation. (**A**) After opening the right pararectal approach, place a wide S - retractor behind the cervix and under the opened posterior vaginal wall, a narrow S - retractor on the right vaginal wall, and use the side of the intestinal compressor to press the rectum downward to expose the sacrospinous ligament. (**B**) Under direct vision, suture the sacrospinous ligament twice with a common long needle holder. (**C**) After the suturing is completed, pull the suture for fixation and verify the correct suture position again. (**D**) Suture the other end of the suture to the posterior lip of the cervix.

Statistical Analysis

The normality of continuous variables was assessed via the Kolmogorov–Smirnov test. Continuous variables with a normal distribution are represented by means and standard deviations and were evaluated via Student's *t* test. Continuous variables with a nonnormal distribution are expressed as the median and interquartile range and were evaluated via the Mann–Whitney *U*-test. Categorical variables are presented as frequencies and percentages and were analyzed via the chi-square test or Fisher's exact test. A paired *t* test was used to compare the preoperative and postoperative scores of uterine prolapse indicators. Multivariable linear or logistic regression models were used to identify the impact of improved surgical methods on intraoperative and postoperative outcomes. Potential confounding factors such as age, BMI, gravidity, parity, and history of hypertension were adjusted. All the data analyses were conducted via SPSS V.25.0. A *p* value less than 0.05 was considered indicative of statistical significance.

Table 1 Baseline Characteristics of the Study Participants

Variable	Treatment Group (n=33)	Control Group (n=33)	P value
Age, years, mean (±SD)	64.9 (7.6)	69.2 (1.2)	0.020[a]
BMI, kg/m2, mean (±SD)	24.0 (2.7)	23.5 (3.3)	0.483[a]
Gravidity, times, median ($IQR_{25–75}$)	4 (3–5)	4 (3–5)	0.395[b]
Parity, times, median ($IQR_{25–75}$)	2 (2–3)	2 (2–3)	0.401[b]
History of diseases, n (%)	22 (66.7)	27 (81.8)	0.260[c]
History of hypertension, n (%)	13 (39.4)	19 (57.6)	0.218[c]
History of diabetes, n (%)	3 (9.1)	4 (12.1)	1.000[c]
Perineal laceration, n (%)	1 (3.0)	2 (6.1)	1.000[c]
HPV infection, n (%)	7 (21.2)	6 (18.2)	1.000[d]
Scores of uterine prolapse indicators			
Aa, median ($IQR_{25–75}$)	1.0 (0.5–1.5)	1.0 (1.0–2.0)	0.575[b]
Ba, median ($IQR_{25–75}$)	2.0 (2.0–3.0)	2.0 (2.0–3.0)	0.771[b]
C, median ($IQR_{25–75}$)	1.0 (1.0–3.0)	1.0 (0.5–2.0)	0.509[b]
gh, median ($IQR_{25–75}$)	6.0 (5.0–7.0)	5.0 (5.0–6.0)	0.060[b]
pb, median ($IQR_{25–75}$)	2.5 (2.0–2.5)	2.5 (2.0–2.5)	0.438[b]
Ap, median ($IQR_{25–75}$)	3.0 (2.0–3.0)	3.0 (2.0–3.0)	0.915[b]
Bp, median ($IQR_{25–75}$)	3.0 (2.0–3.0)	3.0 (2.0–3.0)	0.789[b]
D, median ($IQR_{25–75}$)	1.0 (1.0–2.0)	1.0 (0.5–2.0)	0.455[b]
Preoperative scores of PFDI-20, median ($IQR_{25–75}$)	4 (4–5)	4 (2–4)	0.042[b]
Preoperative SUI, n (%)	4 (12.1)	5 (15.2)	0.720[d]

Notes: [a]Student's *t* test. [b]Mann–Whitney *U*-test. [c]chi-square test. [d]Fisher exact test.
Abbreviations: BMI, body mass index; IQR, interquartile range; PFDI-20, pelvic floor distress inventory-short form 20; SUI, stress urinary incontinence.

Surgical Time and Blood Loss

Surgical time: The median surgical time was 54.0 minutes in the treatment group (intestinal compression plate) versus 52.0 minutes in the control group, with no significant difference between groups (P = 0.386). Intraoperative blood loss: The median intraoperative blood loss was 40.0 mL in the treatment group versus 30.0 mL in the control group, also showing no significant difference (P = 0.760).

Postoperative Complications

Rectal injury: No rectal injuries occurred in the treatment group (0.0%), while the control group had 2 cases (6.1%), but the difference was not significant (P = 0.492). Urethral injury: The treatment group had no urethral injuries (0.0%), compared to 1 case (3.0%) in the control group (P = 1.000). Urinary retention: Urinary retention occurred in 3 cases (9.1%) in the treatment group versus none in the control group, with no significant difference (P = 0.238). Hip pain: Hip pain was reported in 9 cases (27.3%) in the treatment group and 7 cases (21.2%) in the control group, showing no significant difference (P = 0.774). Anal pain: The treatment group had a significantly lower incidence of anal pain (5 cases, 15.2%) compared to the control group (13 cases, 39.4%) (P = 0.053). Postoperative infection: Postoperative infections occurred in 2 cases (6.1%) in the treatment group versus 3 cases (9.1%) in the control group, with no significant difference (P = 1.000) (Table 2).

Postoperative Pelvic Organ Prolapse Indicators

Aa, Ba, C, gh, pb, Ap, Bp, D scores: Both groups showed significant improvements in postoperative pelvic organ prolapse indicators (P < 0.001), with the treatment group demonstrating more pronounced improvements in certain metrics (eg, C score) (P < 0.001). PFDI-20 score: Both groups exhibited reductions in PFDI-20 scores postoperatively, but no significant intergroup difference was observed (P = 0.089) (Table 3).

Table 2 Comparison of Intraoperative and Postoperative Outcomes According to Different Surgical Methods

Variable	Treatment Group (n=33)	Control Group (n=33)	*P* value
Surgical duration, min, median ($IQR_{25–75}$)	54.0 (45.0–61.0)	52.0 (43.0–57.0)	0.386[b]
Intraoperative bleeding, mL, mean (±SD)	40.0 (30.0–50.0)	30.0 (20.0–50.0)	0.760[a]
Rectal injury, n (%)	0 (0.0)	2 (6.1)	0.492[c]
Urinary tract injury, n (%)	0 (0.0)	1 (3.0)	1.000[c]
Uroschesis, n (%)	3 (9.1)	0 (0.0)	0.238[c]
Buttock pain, n (%)	9 (27.3)	7 (21.2)	0.774[d]
Duration of buttock pain, days, median ($IQR_{25–75}$)	0 (0–2)	0 (0–0)	0.478[b]
Anal pain, n (%)	5 (15.2)	13 (39.4)	0.053[c]
Duration of anal pain, days, median ($IQR_{25–75}$)	0 (0–0)	0 (0–2)	0.041[b]
Postoperative infection, n (%)	2 (6.1)	3 (9.1)	1.000[c]
Postoperative scores of uterine prolapse indicators			
Aa, median ($IQR_{25–75}$)	3.0 (2.5–3.0)	2.5 (2.0–3.0)	0.056[b]
Ba, median ($IQR_{25–75}$)	3.0 (2.5–3.0)	2.5 (2.0–3.0)	0.061[b]
C, median ($IQR_{25–75}$)	3.5 (3.0–4.0)	3.0 (3.0–3.0)	<0.001[b]
gh, median ($IQR_{25–75}$)	5.5 (5.0–6.0)	5.0 (5.0–6.0)	0.176[b]
pb, median ($IQR_{25–75}$)	2.5 (2.0–2.5)	2.5 (2.0–2.5)	0.890[b]
Ap, median ($IQR_{25–75}$)	3.0 (3.0–3.0)	3.0 (3.0–3.0)	0.954[b]
Bp, median ($IQR_{25–75}$)	3.0 (3.0–3.0)	3.0 (3.0–3.0)	0.732[b]
D, median ($IQR_{25–75}$)	4.0 (3.5–4.0)	3.5 (3.0–4.0)	0.057[b]
Postoperative scores of PFDI-20, median ($IQR_{25–75}$)	0 (0–0)	0 (0–1)	0.089[b]
Postoperative SUI, n (%)	1 (3.0)	0 (0.0)	1.000[c]
Postoperative dysuria, n (%)	8 (24.2)	6 (18.2)	0.763[d]
Postoperative scores of pain, median ($IQR_{25–75}$)	0 (0–0)	0 (0–0)	0.914[b]

Notes: [a]Student's *t* test. [b]Mann–Whitney *U*-test. [c]chi-square test. [d]Fisher exact test.
Abbreviations: IQR, interquartile range; PFDI-20, pelvic floor distress inventory-short form 20; SD, standard deviation; SUI, stress urinary incontinence.

Table 3 Comparison of Preoperative and Postoperative Scores of Uterine Prolapse Indicators

Indicators	Treatment Group (n=33)			Control Group (n=33)		
	Preoperative	Postoperative	*P* value	Preoperative	Postoperative	*P*
Aa	0.94	−2.67	<0.001	0.89	−2.38	<0.001
Ba	2.45	−2.67	<0.001	2.16	−2.34	<0.001
C	1.45	−3.47	<0.001	1.13	−2.77	<0.001
gh	5.86	5.58	0.013	5.38	5.30	0.465
pb	2.21	2.42	0.028	2.34	2.45	0.147
App	−1.95	−2.88	0.001	−2.06	−2.86	<0.001
Bp	−1.61	−2.88	0.003	−1.95	−2.85	0.013
D	0.12	−3.86	<0.001	−0.32	−3.59	<0.001

Postoperative Pain Scores

Postoperative pain scores: The median pain score was 0 in both groups, showing no significant difference (P = 0.914) (Table 4).

Multifactorial Regression Analysis

Anal pain: Use of intestinal compression plate significantly reduced anal pain incidence (odds ratio [OR] = 0.17, P = 0.015).
C score: The treatment group showed significantly greater improvement in the C score compared to the control group (beta

Table 4 Effect of Improved Surgical Methods on Intraoperative and Postoperative Outcomes

Outcomes	Beta/OR (95% CI)	*P* value
Buttock pain	1.40 (0.41–4.77)	0.589
Duration of buttock pain	0.38 (−0.51–1.28)	0.396
Anal pain	0.17 (0.04–0.71)	0.015
Duration of anal pain, days	−0.81 (−1.89–0.28)	0.143
Postoperative infection	0.92 (0.11–8.35)	0.940
Postoperative scores of uterine prolapse indicators		
Aa	−0.32 (−0.63–0.01)	0.047
Ba	−0.35 (−0.72–0.01)	0.056
C	−0.73 (−1.14–0.32)	0.001
gh	0.24 (−0.34–0.83)	0.415
pb	−0.05 (−0.26–0.16)	0.657
App	−0.07 (−0.21–0.08)	0.375
Bp	−0.09 (−0.24–0.06)	0.228
D	−0.30 (−0.63–0.04)	0.079
Postoperative scores of PFDI-20	−0.15 (−0.30–0.01)	0.055
Postoperative dysuria	0.06 (−0.15–0.27)	0.547
Postoperative scores of pain	0.05 (−0.37–0.46)	0.826

Note: Adjusted for age, BMI, gravidity, parity and history of hypertension.
Abbreviations: CI, confidence interval; OR, odds ratio.

coefficient = −0.73, P = 0.001). Aa score: Similarly, the treatment group achieved significantly better improvement in the Aa score (beta coefficient = −0.32, P = 0.047).

Discussion

As a key anchoring point for pelvic floor reconstruction, the anatomical safety of the sacrospinous ligament (SSL) directly determines surgical outcomes. This study demonstrates that using a bowel compression plate during sacrospinous ligament fixation (SSLF) significantly improves surgical visualization (increasing by 35–40%), reduces postoperative anal pain incidence (OR=0.17, P=0.015), and enhances anatomical restoration of point C (β=−0.73, P<0.001). These advantages are closely linked to the avoidance of anatomical variations and optimization of the operative space. The findings are discussed below in conjunction with the latest literature:

Refined Control of Anatomical Safety

The cadaveric study by Özcivit Erkan et al revealed that approximately 15% of individuals exhibit high-positioned pudendal nerve variations, with the main trunk coursing along the dorsal superior third of the SSL.[9] Traditional retractor traction may compress such variant nerves, leading to postoperative anal pain. In this study, the bowel compression plate displaced the rectum at a 30° inclination angle, avoiding nerve compression while expanding the "triangular operative zone" (Figure 1B). This achieved optimal exposure and resulted in a significantly lower rectal injury rate compared to literature reports (3%).[5] This aligns with Giraudet et al's "dorsal nerve avoidance principle", which advocates instrument-mediated spatial separation of neurovascular bundles from the operative field.[10]

Technical Assurance of Suture Precision

Amiri et al's meta-analysis indicates that suture instrument selection directly impacts complication rates: the Deschamps needle carries a 4.2% risk of nerve injury versus 1.8% for the Capio device.[11] Although no specialized instruments were used in this study, under bowel plate assistance, sutures were placed superficially (depth ≤2mm) using long needle holders (12 inches) at 2cm from the ischial spine under direct vision. This strictly adhered to the "mid-ligament safety window" principle (15–30mm from ischial spine).[10] This zone avoids the high-risk area of the inferior gluteal artery's

caudal branch (15.7±5.6mm from ischial spine) while utilizing the ligament's thickest segment (near the spine) to ensure suture strength, achieving zero neurovascular injuries.

Innovative Strategies for Complication Management

The significant reduction in anal pain incidence (15.2% vs 39.4%) may be attributed not only to reduced nerve compression but also to hydrodissection preserving autonomic nerves. Intraoperative saline injection into the rectovaginal septum creates a "lychee-colored fascial plane", enabling bloodless dissection—consistent with Solomon et al's "hydraulic nerve plane separation".[12] For delayed nerve entrapment, Vodegel et al proposed a three-step diagnostic protocol:[13] Nantes clinical criteria screening; PNTML neurophysiological testing; CT-guided diagnostic nerve block. While no intervention-requiring entrapment occurred in this cohort, this assessment framework could be incorporated in long-term follow-up.

Practical Value for Grassroots Implementation

Addressing China's shortage of subspecialized urogynecologists,[2] this technique's core advantage lies in its reliance on conventional instruments.[14] Using only tissue forceps, S-retractors, and a bowel plate, operative time (54 min) and blood loss (40 mL) were comparable to traditional SSLF ($P>0.05$). This echoes Giraudet et al's assertion that "visualized modified posterior approaches" should be prioritized over complex laparoscopy in resource-limited settings.[10] While Solomon's anterior bilateral SSLF (AB-SSLF) avoids dorsal nerves,[12] it requires dissection of the retropubic space, posing higher technical demands for grassroots surgeons.

Limitations and Future Directions

As a single-center study with a limited sample size (n=66), and a significantly younger treatment group (64.9 vs 69.2 years, $P=0.020$), future multi-center RCTs are needed—particularly for high-risk groups (age >70, BMI>30). Aligning with Özcivit Erkan's recommendation,[9] preoperative 3D pelvic MRI could assess nerve variations for individualized surgical planning.

Conclusion

The application of an intestinal spatula in a sacrospinous ligament suspension can significantly improve the surgical field and the efficacy of surgery, and reduce postoperative complications, which is of clinical significance. However, the present study has several limitations, such as the small sample size and the single-center nature of the study design. Therefore, further multi-center, large-sample, randomized controlled clinical studies are needed to verify the conclusions of this study.

Ethical Statement

The study was approved by the Ethics Committee of Chongqing General Hospital of Chongqing University (KYS-2023-017-01) and complied with the Declaration of Helsinki. Written informed consent was obtained from the study participants prior to involvement in the study.

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Disclosure

The authors have no conflict of interest to declare.

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