

## Preliminary Functional Outcome Following Robotic Intracorporeal Orthotopic Ileal Neobladder with Integrated Pelvic Fascial Structure-Sparing in Males with Bladder Cancer

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**Purpose:** To describe our integrated pelvic fascial structure-sparing (IPFSS) technique for robotic-assisted radical cystectomy (RARC) with intracorporeal orthotopic neobladder (ONB) reconstruction and to evaluate its impact on urinary continence and sexual function in male patients.

**Methods:** This retrospective observational study was conducted at a single high-volume center. Male bladder cancer patients who underwent IPFSS RARC with ONB were included. Demographic, clinical, and pathological data were collected. Functional outcomes were evaluated and compared with a cohort of patients who underwent conventional non-nerve-sparing RARC.

**Results:** Thirty-six patients were included in the IPFSS group and 42 in the conventional group. RARC with intracorporeal urinary diversion was successfully completed in all patients without open conversion. The mean total operative time was 387.9 minutes in the IPFSS group and 392.0 minutes in the conventional group ( $p = 0.465$ ). At 3 months post-surgery, 30 patients (83%) in the IPFSS group achieved daytime continence (0–1 pads), compared to 14 patients (33%) in the conventional group. By 6 months, daytime continence increased to 35 patients (97%) in the IPFSS group, while 28 patients (67%) in the conventional group achieved similar results. At 6 months, 30 patients (83%) in the IPFSS group reported full potency with or without phosphodiesterase type 5 (PDE5) inhibitors, compared to only 3 patients (7%) in the conventional group.

**Conclusion:** We present a feasible surgical technique for RARC that involves holistic preservation of the pelvic fascial architecture. This approach is associated with a rapid recovery of daytime continence and sexual function in male patients.

**Keywords:** cystectomy; intracorporeal; neobladder; pelvic fascial structure-sparing; robotic surgery

### INTRODUCTION

Radical cystectomy (RC) with urinary diversion remains the standard treatment for muscle-invasive and refractory non-muscle-invasive bladder cancer.<sup>(1)</sup> Recently, robotic-assisted radical cystectomy (RARC) has emerged as a promising alternative to the traditional open approach, offering comparable oncologic outcomes with advantages such as reduced blood loss, faster postoperative recovery, and lower perioperative complication rates.<sup>(2,3)</sup>

Neobladder reconstruction is typically reserved for patients in good overall health with a relatively long life expectancy.<sup>(4)</sup> For these individuals, enhancing functional outcomes, particularly urinary continence and sexual function, is as crucial as achieving positive oncologic results. Various techniques have been developed to improve these functional outcomes. Among these, three main approaches have been described: the prostate/prostatic capsule-sparing technique,<sup>(5–7)</sup> the seminal-sparing technique,<sup>(8,9)</sup> and the nerve-sparing technique.<sup>(10,11)</sup> However, concerns have been raised regarding the oncologic safety of prostate-sparing and

seminal-sparing surgeries, particularly the potential risks of residual prostate cancer and urethral tumor involvement.<sup>(12–14)</sup>

The pelvic fascial structure plays a crucial role in stabilizing pelvic organs.<sup>(15)</sup> Radical prostatectomy (RP) often disrupts these structures, leading to both anatomical and functional changes. To address this, several surgical techniques have been developed for pelvic floor reconstruction, including posterior reconstruction, periurethral suspension stitches, and combined anterior and posterior approaches.<sup>(16)</sup> Notably, posterior reconstruction during RARC has been shown to improve continence rates.<sup>(17)</sup> Building on this, we propose that fully preserving the pelvic fascia during RARC could enhance the preservation of tissues related to continence and erectile function, ultimately benefiting patients' functional outcomes. In this paper, we present our technique for integrated pelvic fascial structure-sparing (IPFSS) RARC with intracorporeal urinary diversion (ICUD) and analyze the perioperative and functional outcomes.

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**Table 1.** Clinical patient characteristics.

Variable	IPFSS (n = 36)	Conventional (n = 42)	P value
Age (yr) at diagnosis, mean (SD)	61.2 (6.9)	62.4 (4.7)	0.342
BMI (kg/m <sup>2</sup> ), mean (SD)	23.3 (2.3)	23.5 (2.1)	0.763
ASA score, n	1: 17 2: 19	1: 19 2: 23	0.860
Preoperative therapy, n (%)	None 7 (19) Transurethral resection 12 (33) Neoadjuvant chemotherapy 17 (47)	None 9 (21) Transurethral resection 15 (36) Neoadjuvant chemotherapy 18 (43)	0.927
Pathological stage, n (%)	pT0/pTis/pTa/pT1: 7 (19) ≥ pT2: 29 (81)	pT0/pTis/pTa/pT1: 8 (19) ≥ pT2: 34 (81)	0.964
Total operative time (min), mean (SD)	387.9 (29.1)	392.0 (19.5)	0.465

**Abbreviations:** IPFSS, integrated pelvic fascial structure-sparing; yr, year; BMI, body mass index; ASA, American Society of Anesthesiologists.

**PATIENTS AND METHODS**

**Patients and Study Design**

All patients had pathologically confirmed muscle-invasive or refractory non-muscle-invasive bladder cancer and underwent RARC with ICUD at a single tertiary referral center. All procedures were performed by one highly experienced surgeon (P.W.) who had 8 years of experience with RARC and had performed over 50 procedures prior to this study. The indications and contraindications for orthotopic neobladder conformed to the European Association of Urology guidelines on bladder cancer.<sup>(18)</sup> General patient information is summarized in (Table 1). This retrospective observational study was approved by the local ethics committee (IIT20230289A) and was reported in line with the STROCCS Guideline.<sup>(19)</sup> Demographic, perioperative, and functional data were analyzed. Complications were graded using the Clavien–Dindo classification system.<sup>(20)</sup>

**Surgical Technique**

**Patient Positioning and Port Placement**

The patient was placed in a steep Trendelenburg position, and the da Vinci Si Surgical System (Intuitive Surgical, Sunnyvale, CA, USA) was docked. Port placement is shown in (Figure 1). Four robotic arms were used. Instruments included EndoWrist Instruments, a 30° 10 mm camera, and electrocautery. A powered articulating endoscopic linear cutter (Ethicon, Johnson & Johnson Medtech, Somerville, NJ, USA) was used through the left 12-mm port.

**Pelvic Lymph Node Dissection**

The ureters were dissected and divided close to the ureterovesical junction between two Hem-o-Lok clips, and the distal margins were sent for frozen section. This was

followed by an extended pelvic lymph node dissection (ePLND), including the obturator, common iliac, internal iliac, external iliac, and presacral lymph nodes, as supported by studies demonstrating its prognostic and therapeutic benefit.<sup>(21,22)</sup> The bladder pedicles were then exposed in preparation for bladder resection.

**IPFSS Radical Cystectomy**

1) Posterior Dissection. The assistant retracted the peritoneum, and an incision was made at the anterior surface of the retrovesical pouch. The seminal vesicles and vas deferens were exposed. Denonvilliers’ fascia (DF) was identified and detached from the prostatic base to expose the prostatic fascia (PF). The posterior dissection plane was created between the DF and the PF. Once the dissection reached the posterolateral aspect of the prostate, the PF was separated from the prostate capsule to enter the intrafascial dissection planes (Figure 2A).

2) Retzius Space Exposure and Identification of Pelvic Fascia Landmarks. The lateral and median umbilical ligaments were divided, and dissection was performed between the bladder and the pelvic wall until the Retzius space was fully exposed. The anterior surface of the prostate and bladder neck were defatted to clearly identify pelvic fascia landmarks, including the puboprostatic ligament (PPL), endopelvic fascia (EPF), levator ani fascia (LAF), and fascial tendinous arch of the pelvis (FTAP). The overall route for the cystoprostatectomy was then outlined (Figure 2B).

3) Lateral Dissection. The bladder lateral pedicles were divided using a LigaSure vessel sealer or Hem-o-Lok clips, taking care to avoid damage to the FTAP. As the dissection approached the FTAP, the procedure transitioned to the prostatectomy stage (Figure 2C). The seminal vesicle was retracted medially to expose the posterolateral aspect of the prostate. The EPF, followed

**Table 2.** Early and late complications stratified by Clavien–Dindo classification.

Complication, n (%)	IPFSS (n = 36)	Conventional (n = 42)	Treatment
<b>Early complications (≤ 90 d)</b>			
Clavien grade I–II (Total)	14 (39)	18 (43)	
Fever of unknown origin	7	6	Antibiotics
Paralytic ileus	2	3	Conservative
Lymphatic leakage	2	3	Prolonged drainage
Prolonged urine leakage	2	4	Prolonged drainage
Anemia requiring transfusion	1	2	Transfusion
Clavien grade III–IV	0	0	
<b>Late complications (&gt; 90 d)</b>			
Clavien grade I–II (Total)	1 (3)	1 (2)	
Pyelonephritis	1	1	Antibiotics
Clavien grade III–IV (Total)	1 (3)	2 (5)	
Ureteral anastomosis stenosis	1	2	Laparoscopic reimplantation

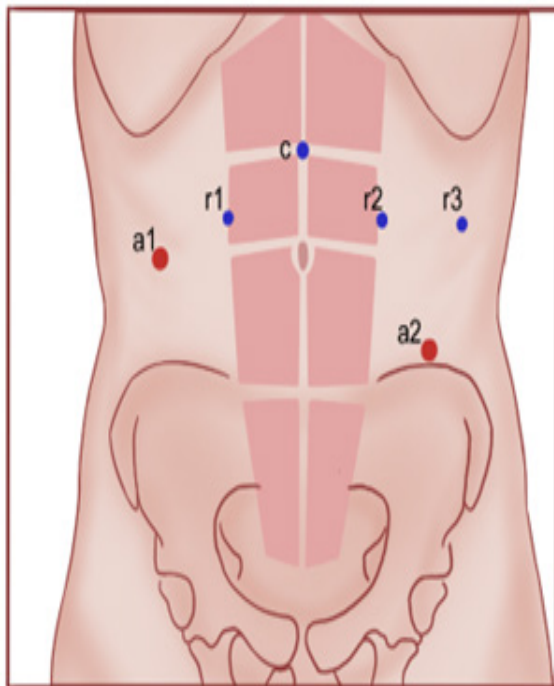
**Abbreviations:** IPFSS, integrated pelvic fascial structure-sparing.

**Table 3.** Continence and potency outcomes.

Variable, n (%)	IPFSS (n = 36)	Conventional (n = 42)	P value
<b>Daytime continence at 3 mo</b>			
0–1 pads	30 (83)	14 (33)	< 0.001
≥ 2 pads	6 (17)	28 (67)	
<b>Daytime continence at 6 mo</b>			
0–1 pads	35 (97)	28 (67)	< 0.001
≥ 2 pads	1 (3)	14 (33)	
<b>Daytime continence at 12 mo</b>			
0–1 pads	35 (97)	33 (79)	0.014
≥ 2 pads	1 (3)	9 (21)	
<b>Nighttime continence at 3 mo</b>			
0–1 pads	21 (58)	11 (26)	0.004
≥ 2 pads	15 (42)	31 (74)	
<b>Nighttime continence at 6 mo</b>			
0–1 pads	25 (69)	16 (38)	0.006
≥ 2 pads	11 (31)	26 (62)	
<b>Nighttime continence at 12 mo</b>			
0–1 pads	25 (69)	23 (55)	0.184
≥ 2 pads	11 (31)	19 (45)	
<b>Potency before surgery</b>			
Potent with or without PDE5i	34 (94)	39 (93)	0.776
Impotent or not sexually active	2 (6)	3 (7)	
<b>Potency at 6 mo</b>			
Potent with or without PDE5i	30 (83)	3 (7)	< 0.001
Impotent or not sexually active	6 (17)	39 (93)	
<b>Potency at 12 mo</b>			
Potent with or without PDE5i	32 (89)	4 (10)	< 0.001
Impotent or not sexually active	4 (11)	38 (90)	

**Abbreviations:** IPFSS, integrated pelvic fascial structure-sparing; mo, month; PDE5i, phosphodiesterase-5 inhibitor.

by the PF, was opened at the lateral base of the prostate (medial to the FTAP). If hemorrhage occurred from a branch of the Santorini venous plexus, suture hemostasis was preferred over bipolar coagulation to minimize thermal injury.<sup>(23)</sup> The lateral intrafascial plane was developed with careful blunt and sharp dissection until the lateral and anterolateral surfaces of the prostate capsule were completely exposed (**Figure 2D**).



**Figure 1.** Port positioning. Point c denotes the placement for the camera trocar, and points r1, r2, and r3 were the positions for the other three robotic trocars. The assistant used two 12-mm trocars (a1 and a2).

4) Anterior Dissection. An incision was made in the anterior base of the prostate, cutting the EPF and the detrusor apron to expose the anterior surface of the prostate. Antegrade anterior dissection was performed between the detrusor apron and the anterior fibromuscular stroma using sharp dissection with electric scissors if needed (**Figure 2E**). When approaching the prostatourethral junction, an avascular plane was identified between the prostate and the dorsal venous complex (DVC). The urethra was then divided, preserving its maximal functional length (**Figure 2F**). The freed specimen was placed in an Endobag, and hemostasis was checked. The preserved pelvic fascial structure is shown in (**Figure 2G, 2H**).

#### Neobladder Reconstruction

A 40 cm ileal segment was identified at least 15 cm from the ileocecal valve. The urethra–ileal anastomosis was performed first, and a segment of ileum extending 30 cm proximal and 10 cm distal to the anastomosis was isolated. Neobladder formation was then performed following the Vescica Ileale Padovana (VIP) technique.<sup>(24)</sup> The distal ureters were implanted using the Nesbit<sup>(25)</sup> or Le Duc technique.<sup>(26)</sup>

#### Follow-up

The drain was removed when output was < 50 mL/day for two consecutive days. Cystography was performed 2 weeks post-procedure to confirm healing before catheter removal. Patients were followed up at 3 month intervals with a physical examination, urine analysis, prostate-specific antigen (PSA), postvoid residual volume (PVR), serum creatinine, electrolytes, and computed tomographic urography (CTU) (**Figure 3**). Continence and erectile function (EF) were assessed using questionnaires. Urodynamic assessment was performed for every patient at 6 months. Daytime and nighttime continence were defined as the use of 0 to 1 safety pad per day. Potency was defined as the ability to achieve and maintain an erection sufficient for sexual intercourse.

**Table 4.** Urodynamics findings at 6 months after surgery in IPFSS group (n = 36).

Variable, median (interquartile range)	Results
Peak flow rate (mL/s)	14 (11–16)
Functional urethral length (mm)	40 (33–45)
Maximal urethral closure pressure (cm H <sub>2</sub> O)	53 (49–61)
Max urethral pressure (cm H <sub>2</sub> O)	78 (67–89)
Neobladder pressure at maximum cystometric capacity (cm H <sub>2</sub> O)	45 (40–53)
Capacity (mL)	296 (245–365)

**Abbreviations:** IPFSS, integrated pelvic fascial structure-sparing.

**Statistical Analysis**

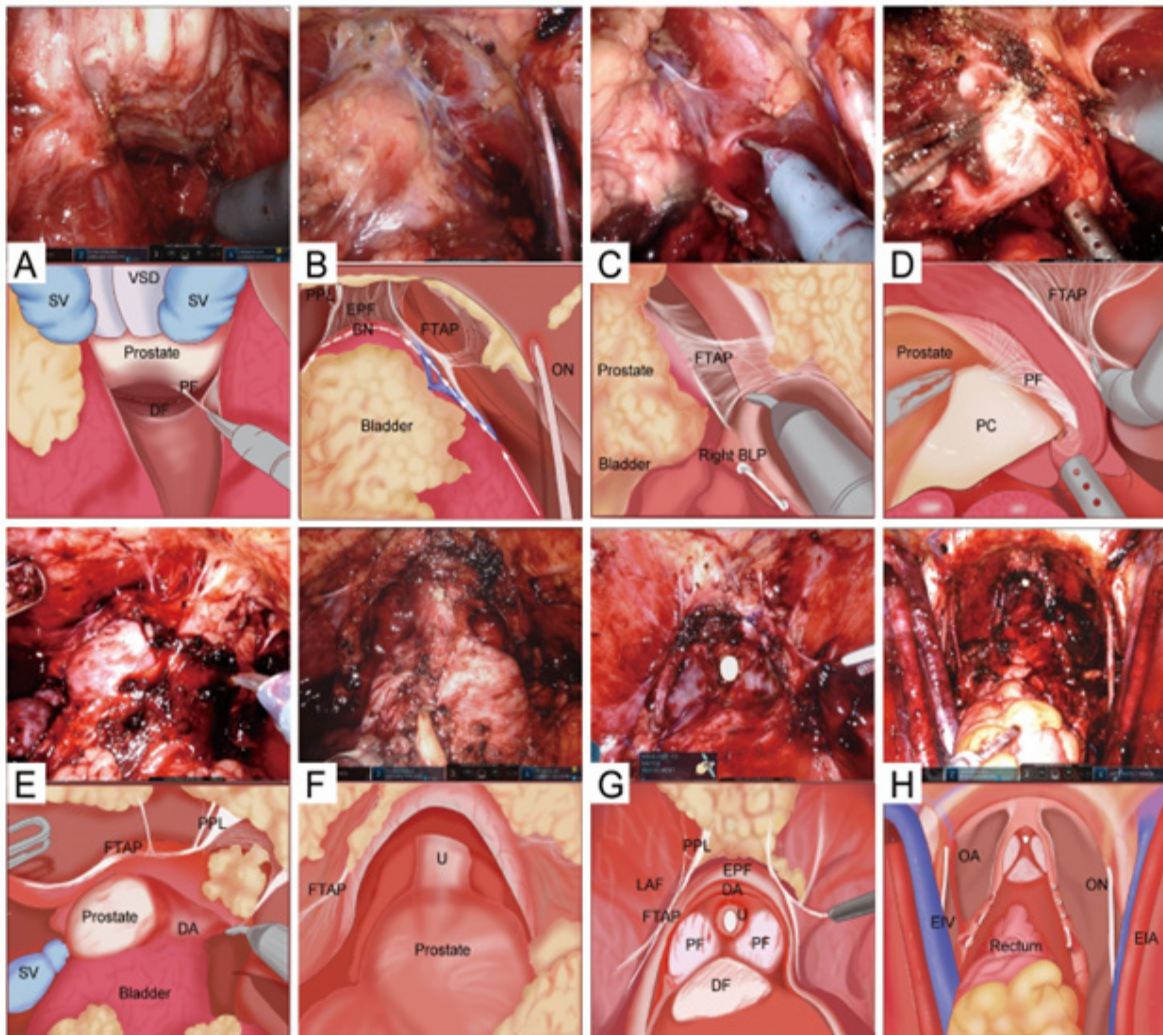
Categorical variables were compared using the chi-square or Fisher’s exact test. Continuous variables were compared using the Student’s t-test or Mann–Whitney U test. Analyses were performed using SPSS version 18, with  $p < 0.05$  considered statistically significant.

**RESULTS**

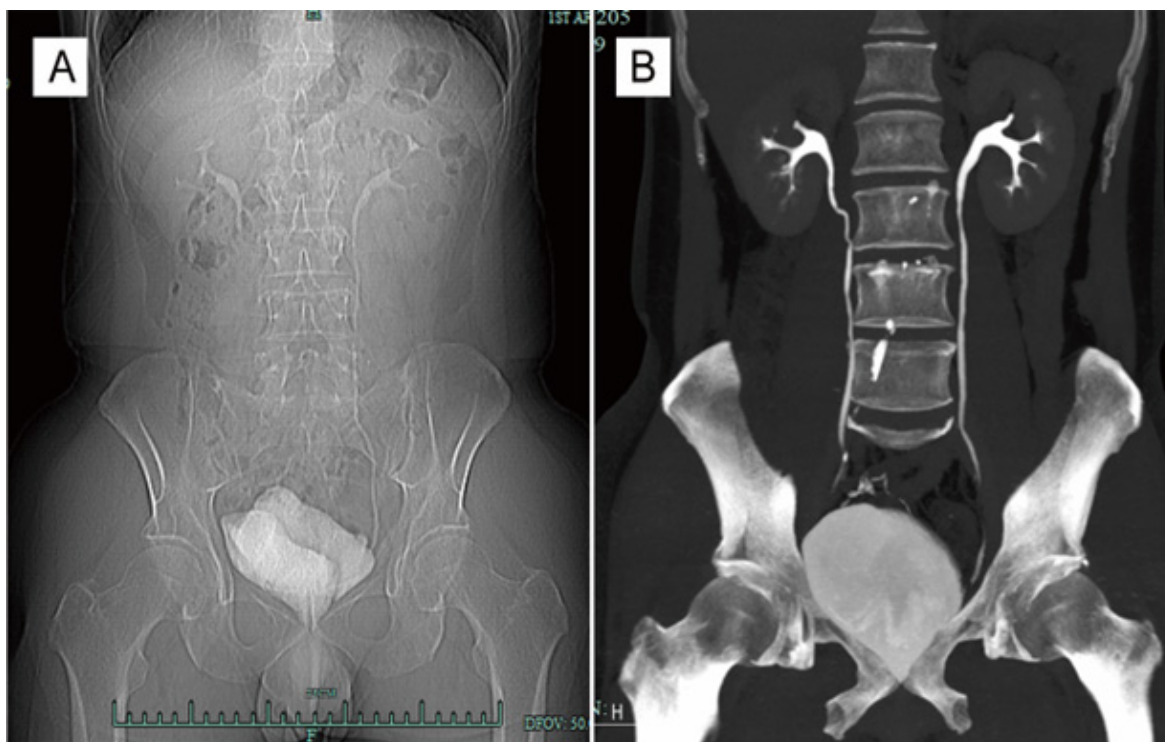
**Characteristics of the Study Population and Perioperative Outcomes**

RARC with ICUD was successfully completed in all 78 patients without open conversion. Baseline and perioperative characteristics were comparable between the IPFSS (n = 36) and conventional (n = 42) groups (Table 1). Neoadjuvant chemotherapy was administered to 17 patients (47%) in the IPFSS group and 18 patients (43%) in the conventional group. The mean total operative time was 387.9 minutes for the IPFSS group and 392.0 minutes for the conventional group ( $p = 0.465$ ). Postoperative adjuvant chemotherapy was administered to 4 patients (11%) in the IPFSS group and 6 patients (14%) in the conventional group for locally advanced disease ( $\geq pT3$  or positive lymph nodes).

**Short-term and Long-term Complications**



**Figure 2.** The critical steps of integrated pelvic fascial structure-sparing robotic-assisted radical cystectomy. (A) At the posterolateral aspect of the prostate, the PF was separated from the prostate capsule and the intrafascial dissection planes entered. (B) Outline of the overall route of the cystoprostatectomy. (C) Once the separation site was close to the FTAP, the surgical procedure needed to transition into the prostatectomy stage. (D) The lateral intrafascial plane was developed with careful blunt and sharp dissection using articulated scissors until complete exposure of the lateral and anterolateral surface of the prostate capsule was achieved. (E) Where the planes did not separate easily with blunt dissection, sharp dissection needed to be used with scissors. (F) The urethra was divided with attention to preserving maximal functional urethral length. (G) and (H) The preserved pelvic fascial structure is displayed. BLP = bladder lateral pedicle; BN = bladder neck; DA = detrusor apron; DF = Denonvilliers’ fascia; VSD = vas deferens; EIA = external iliac artery; EIV = external iliac vein; EPF = endopelvic fascia; FTAP = fascial tendinous arch of the pelvis; LAF = levator ani fascia; OA = obturator artery; ON = obturator nerve; PC = prostate capsule; PF = prostatic fascia; PPL = puboprostatic ligament; SV = seminal vesicles; U = urethra.



**Figure 3.** Computed tomographic urography imaging of an orthotopic neobladder at 6 months after IPFSS-RARC. (A) CT scout image. (B) Three-dimensional reconstruction of CT image using maximum intensity projection technique.

Complication rates were similar between the two groups (**Table 2**). Early perioperative complications ( $\leq 90$  days) occurred in 14 patients (39%) in the IPFSS group and 18 patients (43%) in the conventional group. High-grade complications were rare, with one case of ureteral anastomosis stenosis in the IPFSS group and two in the conventional group.

#### **Oncological Outcomes**

During a median follow-up of 17 months in the IPFSS group, one case of local recurrence was observed, and no patients died. In the conventional group, after a median follow-up of 23 months, two patients died from metastases at 15 and 21 months postoperatively.

#### **Functional and Urodynamic Outcomes**

Patients who underwent IPFSS-RARC had significantly better early continence and erectile function (**Table 3**). At 3 months post-surgery, 30 patients (83%) in the IPFSS group achieved daytime continence, compared to 14 patients (33%) in the conventional group. By 6 months, daytime continence increased to 35 patients (97%) in the IPFSS group, while only 28 patients (67%) in the conventional group achieved similar results. Erectile function also improved significantly in the IPFSS group. At 6 months, 30 patients (83%) reported full potency, with or without PDE5 inhibitors, compared to just 3 patients (7%) in the conventional group. Specifically, 12 of these patients (40%) required PDE5 inhibitors, while 18 (60%) achieved erections without pharmacological support. Urodynamic findings at 6 months in the IPFSS group are detailed in (**Table 4**).

## **DISCUSSION**

Our study demonstrates that IPFSS-RARC with ICUD,

which involves the holistic preservation of the pelvic fascial architecture, is a safe and feasible procedure associated with satisfactory urodynamic findings and excellent continence and sexual function outcomes.

Advances in the understanding of pelvic anatomy have significantly reduced the invasiveness of urological procedures. Our method builds on recent findings about the prostate and surrounding tissues.<sup>(27,28)</sup> Research has shown that preserving pelvic structures during robot-assisted radical prostatectomy (RARP) leads to better functional outcomes. For example, Egan et al. demonstrated that Retzius-sparing RARP enhanced urinary function without compromising oncologic outcomes.<sup>(29)</sup> Similarly, de Carvalho et al. found that preserving the neurovascular bundle and dorsal venous complex during RARP improved functional results.<sup>(30)</sup> Wagaskar et al. recently introduced the “hood technique,” which preserves key pelvic structures and has been associated with an early return to continence.<sup>(31)</sup>

In our study, we applied these principles by performing RARC with a technique that preserves the entire pelvic fascial structure. As anticipated, this contributed to a faster recovery of urinary continence and sexual function. Daytime continence was achieved in 83% of patients at 3 months, increasing to 97% at 6 months. At the 6 month mark, 83% of patients were potent. These preliminary functional outcomes are highly promising. The predictors of continence following RARC remain unclear. A study by Martini et al. on intracorporeal neobladder (ICNB) reconstruction found no significant association between neobladder type and continence.<sup>(32)</sup> Studer has suggested that the surgical technique during cystectomy, rather than the type of neobladder, plays a more critical role in achieving optimal functional outcomes.<sup>10</sup> Several cystectomy techniques have been

introduced to improve patient outcomes. Menon et al. first introduced nerve-sparing RARC in 2003, though functional results were not reported.<sup>(33)</sup> Asimakopoulos et al. later demonstrated that nerve- and seminal vesicle-sparing RARC could provide promising functional outcomes, with 100% daytime continence at 3 months in a highly selective group of 40 patients.<sup>10</sup> More recently, Martini et al. introduced a “lower detrusor apron-sparing” RARC technique, which also yielded positive preliminary outcomes in a small cohort of 11 patients.<sup>(34)</sup>

It is important to note that urodynamic evaluations of ileal neobladders remain limited. In our study, urodynamic tests in the IPFSS group showed excellent functional urethral length and maximal urethral closure pressure, which likely contributed to the rapid recovery of continence. Longer preserved urethral length has been strongly linked to improved continence recovery in RARP.<sup>(35)</sup> In contrast, another study reported that maximal urethral closure pressure dropped to about 40% of preoperative levels after conventional radical prostatectomy without pelvic structure preservation.<sup>(36)</sup> This highlights the importance of maintaining pelvic anatomy to optimize functional outcomes.

While our results show excellent continence rates and a promising proportion of sexually active patients, these findings should be interpreted with caution. Limitations include the study’s retrospective nature, limited sample size, relatively short follow-up, lack of randomization, and single-surgeon series. These factors may influence the generalizability of our conclusions.

## CONCLUSIONS

For male patients undergoing neobladder reconstruction who are motivated to preserve sexual function, IPFSS-RARC with ICUD is a viable option associated with favorable functional outcomes. Further prospective, randomized studies are needed to confirm these findings.

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## CONFLICT OF INTEREST

The authors report no conflict of interest.

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