Original Article

Robotic Freyer's prostatectomy: Operative technique and single-center experience

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ABSTRACT

Introduction: Transurethral resection of prostate replaced open surgery and remained the gold standard in surgical management of benign prostatic hyperplasia (BPH). Holmium laser enucleation and bipolar resection of prostate managed even larger glands. Open simple prostatectomy remains an option for large glands and concurrent pathologies. Minimally invasive laparoscopic simple prostatectomy lacks general acceptance. Surgeons have now started exploring the robotic platform due to its advantages. Herein, we present the technique and initial outcomes of robotic Freyer's prostatectomy (RFP).
Materials and Methods: Thirteen transperitoneal RFPs were performed using the DaVinci Xi platform. We evaluated perioperative characteristics and functional outcomes.
Results: Median patient age was 67.8 years and the mean prostate volume was 105.8 ml. The median International Prostate Symptom Score (IPSS) and American Urological Association quality of life (AUA-QoL) score was 19.6 and 5.3. There were no intraoperative complications or conversion to open surgery. The mean console time and estimated blood loss were 107.30 min and 92.5 ml, respectively. One patient required redo-surgery by robotic technique due to urine leak (Clavien-Dindo Grade 3b complication). Mean hospital stay and catheter duration were 4.9 days and 5.2 days, respectively. Change (preoperative vs. postoperative) in IPSS (19.6 vs. 4.67 points), maximum flow rate (6.8 vs. 15.1 ml/s), AUA-QoL score (5.3 vs. 2.2 points) and PVR (179.4 vs 7.1 ml) were significant (P < 0001).
Conclusions: RFP is a safe and effective option for managing BPH, especially for large glands. It confers minimally invasive surgery benefits with good functional outcomes.

INTRODUCTION

Transurethral resection of prostate (TURP) has remained the gold standard for endoscopic treatment of benign prostate hyperplasia (BPH) due to its excellent and long-term efficacy.[1] The other techniques described for treatment of large gland adenoma are holmium laser enucleation (HoLEP), photoselective vaporization, and bipolar resection.[2-5] Open simple prostatectomy (OP), described by Euegene Fuller (1884),[6] Peter Freyer (1900),[6] and Millin in 1947,[7] remains an option for large glands (>80 g) not manageable with transurethral means and associated with conditions such as concurrent bladder diverticula, stones, and enlarged median lobe. OP is a challenging procedure with a significant complication rate, and HoLEP, although associated with excellent postoperative outcomes and low overall complications rates, has a perceived steep learning curve.[8,9]

Minimally invasive approach such as laparoscopic simple prostatectomy (LSP) was first described by Mariano *et al.*[10] As compared to open approach, laparoscopy

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has equivalent outcomes[11-13] with less blood loss and shorter hospitalization[14] but lacks broad application due to long learning curve, cost, lack of expertise, and endoscopic equipment.[15] The emergence of robotic surgery as a minimally invasive modality added benefits over laparoscopy with enhanced magnification, stability, ergonomics, and dexterity. Sotelo *et al.* described robotic simple prostatectomy (RSP) as a feasible and reproducible procedure.[16] To the best of our knowledge, there are no previously published series of patients undergoing robotic Freyer's prostatectomy (RFP) in treating BPH or refractory lower urinary tract symptoms (LUTS) from the Indian subcontinent. We aim to report our initial experience, technique, advantages, and clinical outcomes of robotic Freyer's prostatectomy done in our institute.

MATERIALS AND METHODS

From March 2018 to May 2020, 13 patients underwent RFP at our institution. Retrospective analysis was done from the prospectively collected database.

Data collection

Baseline variables such as demographic and disease-specific characteristics were noted. Clinical examination with digital rectal examination and International Prostate Symptom Score-American Urological Association (IPSS-AUA) questionnaire was recorded. Routine laboratory tests including prostate-specific antigen (PSA), complete hemogram, and renal function tests were done. All patients underwent abdominal ultrasonography to determine total prostate volume and postvoid residual urine volume (except in cases presented with an indwelling catheter placed due to urinary retention). Patients with high PSA underwent a complete workup for prostate cancer including TRUS-guided prostate biopsies. In patients presenting with hematuria, a complete workup was done to rule out other causes. After extensive counseling about different treatment options such as OP and minimally invasive techniques such as TURP and HOLEP, patients who opted to undergo RSP were reviewed. Perioperative characteristics, console time, total operative time, blood loss, hospital stay, blood transfusion requirements, complications, and catheterization time were analyzed. The weight of resected prostate gland and pathology found on histopathological examination (HPE) was noted. Follow-up assessment included DRE, IPSS-AUA questionnaire, uroflowmetry, and ultrasound abdomen with postvoid residue (PVR).

As this was a retrospective study, an informed consent for inclusion in the study from participants was not taken. However, all the participants provided a written informed consent for undergoing surgery and we adhered to the principles of Helsinki Declaration, 1964 (amended in 2013). We confirm the availability and access to all the original data reported in this study.

Surgical technique

Patient position and port placement

All procedures were performed with a four-arm da Vinci-Xi Surgical System (Intuitive Surgical, Sunnyvale, CA). A transperitoneal access achieved and five ports was placed as shown in Figure 1, with patient in supine position. Docking of robot done after placing the patient in steep Trendelenburg position. Four instruments were used: monopolar curved scissors, bipolar forceps, prograsp forceps, and a large needle driver. Intermittent pneumatic compression device was used in the lower limb.

Transverse cystotomy

The bladder was filled with 300 mL of saline. A transverse cystotomy was made just below the bladder's dome to expose the prostate base and the trigone. The adenoma and the ureteric orifices were identified. The few added advantages of transverse cytotomy include better exposure of bladder neck and prostate and hence easy tackling of median lobe. Dropping of bladder is not required; hence anterior wall remains static and only retraction of posterior wall was required.

Dissection of the adenoma

A circumferential incision was placed on the mucosa covering the adenoma near the bladder neck [Figure 2a]. At 6'o'clock, the incision was deepened till an avascular plane between the adenoma and prostatic capsule was identified. The dissection was then continued circumferentially in the same plane sweeping laterally and anteriorly. Adenoma was retracted with prograsp, and enucleation was achieved with electrocautery and blunt dissection [Figure 2b]. After completing the posterior and lateral dissections, anterior dissection was performed to expose the urethra at the apex where the urethra was divided under direct vision, also there should be no undue traction over the adenoma during apical dissection and electrocautery usage should be minimized to

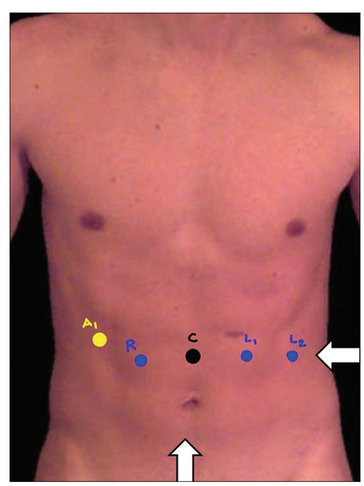

Figure 1: Port placement for robotic Freyers' prostatectomy (daVinci Xi system) C = Camera port (8 mm), R = Monopolar scissors (8 mm), L1 = Fenestrated Bipolar (8 mm), L2 = Prograsp forceps (8 mm), A1 = Assistant port (12 mm), Lens: 0°, White arrow with black outline: Direction of docking

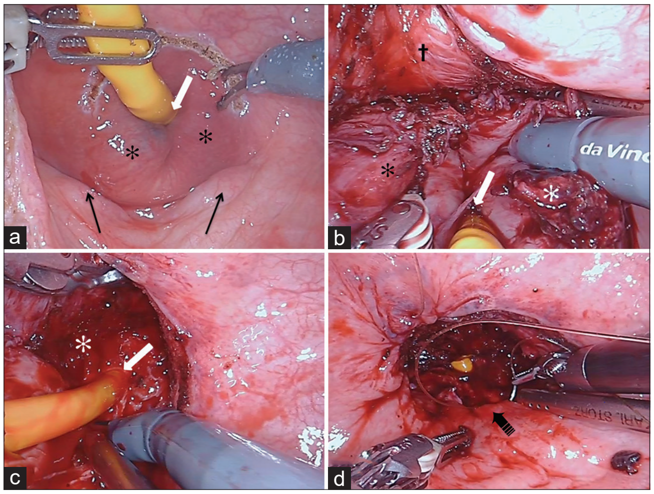

Figure 2: Intra-operative photographs for demonstration. (a) Mucosal incision near bladder neck. (b) Splitting of adenoma to access urethra (c) Cutting the urethra and safe guarding the sphincter. (d) Trigonisation of prostatic urethra (black arrows-ureteric orifices, white arrow–urethra with Foleys catheter, *Adenoma, white asterisk-separated adenoma, †Compressed prostate tissue, ➡Advancement of trigonal flap)

avoid damage of external sphincter [Figure 2c]. If the gland size was large and access to the urethra difficult, the gland was bivalved vertically along the anterior commissure to reach the urethra. Hemostasis was achieved with bipolar cautery.

Advancing of the bladder neck mucosa to the urethra and closure of the bladder wall

The "trigonization" of the prostatic urethra was performed by approximating the posterior bladder neck to the posterior urethra with continuous 3-0 barbed sutures (Stratafix®) in a circumferential manner (360°) avoiding purse-stringing and taking care to avoid incorporation of the ureteric orifices [Figure 2d]. A 22F three-way Foleys catheter was placed, the balloon inflated up to 30 cc, suprapubic catheter (SPC) was inserted, and cystotomy was closed in two layers using 3-0 V-Loc. Continuous bladder irrigation with normal saline was immediately initiated, and traction was given. After the first layer, the bladder was filled to perform a leak test and confirm watertight closure, following which a second layer of sutures were placed. Drain was placed anteriorly, and specimen was extracted through assistant port after placing in a bag. Port sites were closed in a standard fashion.

Postoperative management

Deep vein thrombosis (DVT) prophylaxis was continued with intermittent pneumatic compression device and low molecular weight heparin was required in two patients for 48 h as per our hospital protocols, as there was delay in mobilisation. The SPC was clamped, and the per urethral catheter was typically removed on postoperative day 5. Patients were discharged with antibiotic prophylaxis. The SPC was removed 48 h after the removal of the urethral catheter. Uroflowmetry and IPSS were recorded at 3 months during the follow-up.

Statistical analysis

We used SPSS Statistics v20.0 (IBM Corp, NY, USA) software for the statistical analysis. Descriptive statistics, including mean, median, range, interquartile range (IQR), and statistical significance, were used to report scale and categorical data. Inferential statistics, including statistical significance, were determined using a two-sided significance level of 0.05 calculated using paired *t*-test to compare means.

RESULTS

We studied 13 patients who underwent RFP by a single surgeon. Median follow-up was 29 months (IQR: 10–33), and median patient age was 67.8 years (IQR: 60.7–75.2). All the 13 patients had failed medical management, five (38.4%) patients presented with acute urinary retention with an indwelling catheter, one (7.6%) had recurrent hematuria and urinary tract infection, and the other seven (53.8%) patients presented with LUTS refractory to medical management. Median duration of medical management was 24 months (IQR: 17–52).

Two patients had renal cancer, one patient underwent robotic bilateral partial nephrectomy in 2015, and another patient underwent open radical nephrectomy in 2009, and both were disease free at the time of presentation. Other comorbidities included diabetes mellitus in two patients, hypertension in eight patients, cholecystectomy history in one patient, and appendicectomy in one patient. One had chronic kidney disease, and one was on antiplatelet after coronary artery bypass graft. On digital rectal examination, the prostate was firm in consistency with free and mobile rectal mucosa in all 13 patients.

Preoperative parameters

Median PSA level was 2.5 ng/ml (IQR: 0.9–11.4), and mean prostate volume was 105.8 (IQR: 47–220) [Table 1]. One patient had a high PSA of 21 ng/ml, but his biopsy and mpMRI were normal. He underwent RFP, and the histopathological analysis of the specimen showed low volume (<2%) prostate cancer of Gleason score 3 + 3. He was counseled and kept on active surveillance, his PSA at 6-month follow-up is 0.14 ng/ml. Second patient underwent TRUS-guided biopsy twice in 2017 and 2018 for persistently elevated PSA levels of 9.3 ng/ml; however, there was no evidence of malignancy. Due to persistently high PSA, he was advised to undergo biopsy again. The patient refused biopsy and opted to undergo RFP. The postoperative histopathological report had no evidence of cancer. Third patient had a persistently high PSA of 17.21 ng/ml with a normal mpMRI and biopsy. He, too, underwent RFP, and the histopathological analysis of the specimen showed benign prostatic hyperplasia. The median IPSS and AUA-quality of life (AUA-QoL) score ($n = 6$) was 19.67 (IQR: 15.0–22.2) and 5 (IQR: 3.85–6.15). Mean PVR was 179.4 ($n = 6$, range: 34–245 ml).

Table 1: Baseline demographic details, peri-operative findings and, postoperative complications in patients treated with robot-assisted Freyer's prostatectomy

Variables	Value
Patients demographics	
Age (years) (IQR)	67.8 (60.7-75.2)
PSA (ng/ml) (IQR)	2.5 (0.9-11.4)
Prostate volume (ml) (range)	105.8 (47-220)
Presentation, *n* (%)	
Refractory LUTS	7 (53.8)
Recurrent hematuria + UTI	1 (10)
AUR	5 (38.4)
Perioperative parameters	
Operative time (min) (range)	107.30 (90-120)
Estimated intraoperative blood loss (ml) (range)	92.5 (83.8-101.6)
Postoperative transfusion, *n* (%)	1 (10)
Catheterization duration (days) (range)	5.2 (5-7)
Length of hospital stay (days) (range)	4.9 (4-9)
Specimen weight (g) (range)	82.8 (45-157)
Complications (clavein dindo grades), *n* (%)	
None	7 (70)
Grade 1	2 (20)
Grade 2/3a	0
Grade 3b	1 (10)
Grade 4/5	0

Data are presented as median (IQR) for continuous variables and as percentage age or mean (range) for categorical variables. IQR=Interquartile range, LUTS=Lower urinary tract symptoms, UTI=Urinary tract infection symptoms, AUR=Acute urinary retention, AUA Qol=American Urological Association quality of life score, *n*=Number of patients, PSA=Prostate-specific antigen

Perioperative parameters

The mean console time and estimated blood loss were 107.30 min (range: 90–120) and 92.5 ml (range: 80–120), respectively. There were no intraoperative complications or conversion to open surgery. Postoperative complications were classified as per modified Clavein Dindo scale. Two patients needed adding antiemetics or diuretics (Grade 1). One patient in whom SPC was not placed developed clot retention and urinary leak into the peritoneal cavity on day 2. He was re-operated, and the bladder rent resutured by robotic approach (Grade 3b); the same patient also received a blood transfusion. Patient did well postoperatively. Mean hospital stay and catheter duration were 4.9 days (range 4–9) and 5.2 days (range: 5–7), respectively.

On HPE, the specimens' mean weight was 82.8 g (range: 45–157). All patients had BPH, with six patients with chronic prostatitis, and one patient with PSA 21 ng/ml showed low volume, low grade (Gleason score 3 + 3 = 6) prostate cancer. One patient developed soft urethral stricture, which was managed by self-intermittent catheterization for 2 months, and doing well now. All other patients were asymptomatic and without any complications.

Functional outcomes

On follow-up, changes (preoperative vs. postoperative) in IPSS (19.6 [range 15–22] vs. 4.67 points [range 2–7], average change = 15 points ± 3.16), maximum flow rate (Qmax) (6.8 ± 0.69 ml/s vs. 15.1 ± 1.13 ml/s, average change = 8.4 ± 1.3 ml/s) AUA-QoL score (5.3 ± 2.5 vs. 2.2 ± 0.7, average change = 3.1 ± 1.3), and PVR (179.4 ± 75 vs. 7.14 ± 9.5, average change 172.28 ± 80.7 ml) were significant (P < 0001) [Table 2].

Five patients had severe LUTS, predominantly of irritative symptoms and also had transient incontinence of mild grade. Three of them recovered in 2 weeks, one recovered after 3 weeks, and one patient took 2 months to recover complete continence. All the patients used 1–2 pads per day and were mananged with bladder relaxants and pelvic floor exercises. Currently, all the patients are continent without any LUTS.

DISCUSSION

We report our initial experience with RFP in treating patients with refractory LUTS due to large prostatic adenoma. Surgical treatment of BPH by suprapubic prostatectomy (Fuller 1884) or transvesical prostatectomy (Freyer 1900) was associated with a mortality rate of 18% and 5%, respectively.[6] These remained the preferred approach for the next 50 years until Sir Terence Millin[7] popularized prostatic adenoma enucleation by open surgery in 1945. Later, TURP became the standard for treating small and moderate-sized prostate[1] but with a limited role in larger glands due to associated perioperative morbidity and mortality.[13] EAU 2020 guidelines mentioned open prostatectomy and enucleation techniques such as holmium laser or bipolar enucleation of the prostate as the first practical and durable treatment option in men with a substantially enlarged prostate moderate to severe LUTS.[12]

The array of treatment options for men with BPH are increasing day by day. Adopting newer endoscopic and other minimally invasive techniques has been growing over traditional TURP or OP options. With the advent of minimally invasive surgery such as laparoscopy and robotic surgeries, more options are available for older patients with comorbidities presenting with large prostate. LSP was first described by Mariano *et al.*[10] and has been more often performed over the past decade. Several series have reported its equivalence to the open approach in improving symptoms and quality of life.[11,14,15] Few even showed lesser blood loss and shorter hospitalization duration with laparoscopic approach[14] but not much favored due to its technical difficulty and not much improvement over side-effect profile compared to conventional OP.[11]

The popularity and acceptance of robotic surgery in urology[17] have allowed the urologists to simulate open surgery methods using a robotic platform.[18] The improved dexterity and 3D vision on the robotic platform enable the surgeon to do a more precise anatomic dissection of the adenoma and facilitates accurate intracorporeal suturing. These factors, when combined, offer excellent perioperative outcomes as well as durable, functional improvements.

Table 2: Functional outcomes in patients treated with robot-assisted Freyer's prostatectomy

Variable	Preoperative	Postoperative	Mean change	*P*
PVR volume	179.4±75	7.14±9.5	172.28±80.7	<0.005
Qmax (ml/s)	6.8±0.69	15.1±1.13	8.4±1.3	<0.001
IPSS	19.6±2.5	4.67±1.03	15±3.16	<0.001
AUA QoL score (part of IPSS-AUA score)	5.3±2.5	2.2±0.7	3.1±1.3	<0.001

PVR=Postvoid residue, Qmax=Maximum flow rate, AUA Qol=American urological association quality of life score, IPSS=International prostate symptom score

Several centers worldwide have reported small case series with perioperative and functional results similar to HoLEP and OP.[16,19-33] [Table 3]

Several proposed techniques for RSP have diverse complication profiles.[33] Chung *et al*. reported the extraperitoneal approach associated with less bowel-related complications and less postoperative pain than the transperitoneal method.[34] In our series, we performed the transperitoneal horizontal cystotomy incision without dropping the bladder and capsulotomy. Operative time can vary according to expertise, decreases with experience. Our mean operative time was 110 min, comparable to the series found in literature on simple robotic prostatectomies irrespective of the approach.[19,22,30]

OP has a high rate of perioperative bleeding and blood transfusion rate than HoLEP.[35,36] The overall transfusion rate of RSP has been less, except the Sotelo *et al*. series, where 14% required transfusion. Contributing factors could be the pneumoperitoneum tamponade of open venous channels within the prostatic fossa, excellent 3D vision, and the robotic instruments' dexterity allowing accurate hemostasis. One patient (7.6%) had Clavein Dindo Grade 3b complication needing transfusion in our series. In the robotic approach series, the mean stay was 1–3 days[16,19,23,26] This can be attributed to adequate hemostasis allowing earlier cessation of bladder irrigation and more premature discharge. Our mean hospitalization stay was 5 days.

RFP has a good functional outcome comparable to the HoLEP and OP series.[28,36,37] Our study showed a significant change in IPSS score, PVR, Qmax, and AUA-QoL at 1 year. We could not find any data analyzing the long-term functional outcomes following an RSP. Nevertheless, if we were to extrapolate the observations recorded in few OP series, IPSS, Qmax, and PVR improvements are longstanding with low reoperation rates (~2-5%).[27] Nearly 30% of our patients were followed up for almost 2 years with good functional outcomes. The sustainability of the procedure depends on the amount of adenoma removed. The robotic approach allows for almost complete enucleation of the adenomatous tissue due to arm dexterity. Our mean pathology specimen weight was 82.8 g, with other series reporting between 46 g and 162 g on an average.[16,19-33]"Trifecta" arbitrarily included (a) no perioperative complications, (b) postoperative IPSS <8, and (c) postoperative Qmax > 15 ml/s.[27] Although it needs external validation, many researchers[27,38] recognized that this might be a simple way to define successful outcomes. In our study, the trifecta rate was 40%.

The advantage of performing RSP is also the ability to treat coexistent pathology.[28] In our series, none had any concomitant pathology, which had to be dealt with separately. In our institution, we started robotic Freyers' prostatectomy with prior experience of >500 robotic radical prostatectomies, which was crucial in predicting the learning curve mentioned by investigators such as Wang *et al*.[30]

Urethral microtrauma and consecutive urethral stricture are more in endoscopic procedures (1.8-2.2%)[39] than of RSP (0.6%).[27] We had one patient who had a soft stricture managed by a short period of urethral calibration. The overall costs of RSP are less than for OP and equivalent to TURP.[22] Even though the initial operative costs were higher for RSP, the hospitalization costs were lower.[22] Lee *et al*.,[40] after an online survey of 600 urologists, concluded that decision-making in the surgical management of BPH (any approach) is not based on economic factors but patient safety, procedure efficacy, own experience.[28] We had small numbers to do a cost-analysis.

Limitations

Our study does have limitations. It is a small sample size; a larger patient cohort would power the study and determine reproducibility. Second, the variation in the follow-up duration is not enough to analyze long-term outcomes. Finally, cost-analysis could not be done in the present study.

CONCLUSIONS

RFP is a safe and effective procedure; it confers benefits of minimally invasive surgery with low postoperative complications in surgical management of BPH. Prospective, multicenter, and large sample size studies will reinforce these findings further.

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Table 3: Summary of different series of robot assisted simple prostatectomies in world literature

Author name	Number of patients	Mean age (years)	Mean preoperative IPSS	Mean operative time (min)	Mean operative blood loss (ml)	Mean resected prostate (g)	Catheterisation time (days)	Median preoperative Qmax (ml/s)	Median postoperative Qmax (ml/s)	Mean postoperative IPSS
Sotelo *et al*., 2008[11]	7	64.7	20.9	195	382	50.5	7	17.7	55.5	7.5
Yuh *et al*., 2008[19]	3	76.7	17.7	211	558	301	NR	NR	NR	NR
John *et al*., 2009[21]	13	70	NR	210	500	82	6	NR	23	NR
Uffort and Jensen, 2010[20]	15	65.8	23.9	128.8	139.3	46.4	4.6	NR	NR	8.13
Sutherland *et al*., 2011[23]	9	68	17.8	183	206	112	13	NR	NR	7.8
Vora *et al*., 2012[24]	13	67.1	18.2	179	219	163.8	8.8	4.37	19.1	5.3
Matei *et al*., 2012[22]	35	65.2	24	186	121	87	7.4	7.5	18.3	5
Falavolti *et al*., 2017[25]	18	74	8	205	200	100	5.6	NR	NR	25.2
Banapour *et al*., 2014[26]	16	68.4	22	228	197	94.2	8	NR	NR	7
Leslie *et al*., 2014[28]	25	72.9	23.9	214	143	88	9	11.3	20	3.58
Pokorny *et al*., 2015[29]	67	69	25	97	200	84	3	7	23	3
Wang *et al*., 2016[30]	10	68	25.1	150	100	79	12	9.9	24.5	NR
Mourmouris *et al*., 2019[33]	26	66.7	22.87	134	274	115.3	3	10.11	19.12	5.7
R.Dotzauer *et al*., 2021[34]	103	71	17.3	182	248	NR	6	6.1	NR	NR
Present series, 2021	13	67.8	20.5	107	92.5	82.8	5	7	15.1	4.9

NR=Not recorded in the study, Qmax=Maximum flow rate, AUA Qol=American urological association quality of life score, IPSS=International prostate symptom score

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