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Comparison of Laparoscopic and Open Radical Prostatectomy in Terms of Surgical Efficacy and Safety of Initial Cases: A Single-center Retrospective Study

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What's known on the subject? and What does the study add?

Laparoscopic radical prostatectomy has been shown to provide perioperative benefits compared to open radical prostatectomy, especially in terms of reduced blood loss, lower transfusion rates, and shorter hospital stays; however, its steep learning curve can affect early perioperative and functional results. This study contributes to the literature by demonstrating that even during surgeons' initial radical prostatectomy cases, the laparoscopic approach was associated with more favorable perioperative outcomes and improved early urinary continence, while achieving similar early oncological outcomes, including positive surgical margins and short-term prostate-specific antigen recurrence rates, compared to the open approach.

Abstract

Objective: Surgeons aiming to adopt minimally invasive techniques may initiate laparoscopic radical prostatectomy (LRP) either after performing a certain number of open procedures or even without prior open surgical experience. This study aimed to evaluate the feasibility, safety, and efficacy of LRP performed without previous open radical prostatectomy (ORP) experience.

Materials and Methods: This retrospective analysis included the initial ORP and LRP cases performed by two surgeons who had no prior experience with either approach before completing their residency training. Demographic, perioperative, pathological, and postoperative functional outcomes at 12 months were compared between the two groups.

Results: Sixty patients were analyzed (ORP: 30, LRP: 30). Baseline characteristics were similar (p>0.05). Operative time was comparable (p=0.849). Intraoperative blood loss was significantly lower in the LRP group (200 mL vs. 950 mL, p=0.001). Hospital stay was shorter for LRP (5 vs. 6 days, p=0.004). Continence rates favored LRP (100% vs. 60% continent; <0.001), whereas erectile function recovery was comparable. Minor complications occurred in 18% overall, with no major complications (Clavien ≥III). Positive surgical margin rates were 20% for ORP and 17% for LRP (p>0.99). Biochemical recurrence at 12 months (prostate-specific antigen >0.2 ng/mL) was observed in 10% of patients in both groups (p>0.99).

Conclusion: LRP, even when performed by surgeons without prior ORP experience, achieved superior perioperative outcomes and better early continence recovery while maintaining early oncological control. In centers with limited access to robotic surgery due to high costs and restricted availability of trained surgeons, laparoscopy remains a safe and effective alternative for radical prostatectomy.

Keywords: Radical prostatectomy, open surgery, laparoscopy

Introduction

Prostate cancer is the world's second most frequently diagnosed malignancy in men and continues to be a leading cause of cancer-related death, particularly in developed countries. Radical prostatectomy represents a standard curative treatment for patients with clinically localized prostate cancer, providing excellent long-term oncological control in appropriately selected cases (1).

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Historically, open radical prostatectomy (ORP) has been widely performed and has served as an established surgical approach for localized prostate cancer. However, the development and widespread adoption of minimally invasive surgical techniques have led to increased use of laparoscopic radical prostatectomy (LRP), which may offer several advantages, such as reduced blood loss, shorter hospitalization, and reduced postoperative pain (2).

Despite these potential benefits, the laparoscopic approach is technically demanding, characterized by a long learning curve that can influence oncological results, especially during the surgeon's initial experience (3). Previous studies, comparing ORP and LRP, have reported mixed results; differences in perioperative morbidity, operative time, oncological outcomes, and functional results often vary depending on surgeon expertise, institutional experience, and patient characteristics (4-6).

In this retrospective analysis, we sought to compare the preoperative, intraoperative, and postoperative outcomes of patients undergoing open and LRP at our center, performed by two surgeons who had no prior experience with the procedure. By evaluating objective clinical data, we aimed to clarify the safety, efficacy, and feasibility of both surgical techniques for initial cases in routine practice.

Materials and Methods

Study Design and Setting

This single-center, retrospective, comparative cohort study, conducted in the Department of Urology of Marmara University Training and Research Hospital, included patients who underwent radical prostatectomy for localized prostate cancer between March 2021 and May 2024. The study was approved by Marmara University Faculty of Medicine Non-Drug and Non-Medical Device Research Ethics Committee (approval number: 09.2025.25-0501, date: 20.06.2025). Written informed consent was obtained from all participants.

Patient Selection and Grouping

Patients were divided into two groups based on the initial surgical approach, which was performed by two different surgeons: Group 1 (ORP) and Group 2 (LRP).

Eligible patients were identified from the institution's surgical database. The inclusion criteria were: histopathologically confirmed prostate adenocarcinoma; treatment by either open or LRP; availability of complete perioperative and follow-up data; and a minimum follow-up period of twelve months. Patients were excluded if they had a history of pelvic surgery or radiotherapy, evidence of metastatic disease at diagnosis, prior neoadjuvant therapy, or incomplete clinical records.

Surgical Techniques

ORP was performed through a lower midline extraperitoneal retropubic approach. Nerve-sparing and pelvic lymph node dissection (PLND) were selectively performed based on the preoperative the European Association of Urology (EAU) risk assessment and intraoperative factors, including surgical exposure, anatomical difficulty, comorbidity status, and the surgeon's assessment of technical feasibility for both approaches.

LRP was performed via a transperitoneal five-port technique. Standard steps included seminal vesicle dissection at the posterior aspect of the prostate, anterior mobilization of the prostate, ligation of the dorsal venous complex, bladder neck transection, preservation of the neurovascular bundles when feasible, and urethrovesical anastomosis.

The surgeries were performed by two surgeons, each with 5 years of urology training. The surgeon performing the open surgery had prior experience in other open oncologic procedures, while the surgeon performing the laparoscopic surgery had extensive experience in other laparoscopic procedures.

Data Collection and Variables

Demographic, clinical, and surgical data were obtained retrospectively from the hospital information management system and surgical records. The following parameters were recorded:

Preoperative Variables

Age, preoperative prostate-specific antigen (PSA) level, digital rectal examination findings (benign vs. malignant), prostate volume, and biopsy International Society of Urological Pathology (ISUP) grade, preoperative urinary continence and erectile function (the ability to achieve penetration with or without the use of phosphodiesterase-5 inhibitors). Patients were preoperatively classified as low-, intermediate-, or high-risk according to EAU risk stratification.

Perioperative Variables

Surgical approach (ORP vs. LRP), PLND (yes/no), nerve-sparing status (categorized as performed or not performed), operative duration, estimated blood loss, and need for intraoperative transfusion.

Postoperative Variables

Hospital stay, duration of catheterization, need for postoperative transfusion, complications (classified according to Clavien-Dindo), positive surgical margin (PSM) status, final pathological ISUP grade and stage, serum PSA level, urinary incontinence status (patients using no pads or only one safety pad per day were considered continent, whereas those requiring more than one pad per day were considered incontinent), and erectile function status (presence or absence of erections sufficient for penetration, with or without medication).

Follow-up Protocol

Postoperative follow-up visits were conducted at 10-14 days (for catheter removal and wound evaluation) and at 1, 3, 6, 9, and 12 months. Serum PSA levels were routinely assessed from the third postoperative month onward and at each subsequent follow-up visit. Persistent PSA was defined as a PSA level of ≥0.2 ng/mL at the first postoperative PSA assessment, whereas biochemical recurrence was defined as a subsequent detectable or rising PSA level of ≥0.2 ng/mL confirmed on two separate measurements after having achieved an undetectable postoperative PSA level. Urinary continence and erectile function outcomes were assessed clinically and documented by patient self-report at 12 months.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 25 (IBM Corp., Armonk, NY, USA). Normality of continuous variables was evaluated visually (histograms and probability plots) and with the Kolmogorov-Smirnov and Shapiro-Wilk tests. Variables that do not conform to a normal distribution are reported as the median and interquartile range (IQR). The Mann-Whitney U test was used to compare two independent groups for non-parametric continuous and ordinal data. Categorical variables are presented as frequencies (%) and contingency tables. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. ISUP grade distributions across groups were analyzed using the chi-square test. A p-value <0.05 was considered statistically significant.

Results

A total of 60 patients who underwent radical prostatectomy were included in the study, of whom 30 had ORP and 30 had LRP. The mean age was slightly higher in the LRP group (67.6±7.4 years) compared to the ORP group (65±6.3 years), although this difference was not statistically significant (p=0.212). The preoperative median PSA level was 7.6 ng/mL (IQR: 5.5-9.6) in the ORP group and 5.8 ng/mL (IQR: 4.6-10.6) in the LRP group (p=0.25). Digital rectal examination findings were comparable between the groups (benign findings: 60.0% in the ORP group vs. 50.0% in the LRP group, p=0.604).

No significant differences were observed between the groups for preoperative prostate volume (median 44.5 mL in ORP vs. 41 mL in LRP, p=0.968) or the biopsy ISUP grade distribution (p=0.486). Risk classification was similar between groups, with low-, intermediate-, and high-risk disease observed in 40.0%, 43.3%, and 16.7% of patients in the ORP group in and in 36.7%, 56.7%, and 6.7% of patients in the LRP group, respectively (p=0.394). All patients were continent preoperatively. Furthermore, all patients reported erections sufficient for penetration, with or without the use of phosphodiesterase-5 inhibitors. All comparative outcomes are shown in Table 1.

Perioperative Outcomes

The median operative time was similar between the groups: 253 minutes (IQR: 231.3-301.5) for ORP and 240 minutes (IQR: 240-270) for LRP (p=0.849). In contrast, estimated intraoperative blood loss was significantly greater in the ORP group (median 950 mL, IQR: 700-1625) than in the LRP group (median 200 mL, IQR: 150-300) (p=0.001). Likewise, the requirement for intraoperative transfusion was substantially higher in the open surgery cohort (60% vs. 0%, p<0.001). Nerve-sparing status (performed vs. not performed) differed significantly between the groups, with a higher rate in the LRP group (66.7% vs. 26.7%, p=0.004). PLND was performed significantly more often in the ORP group (47%) than in the LRP group (17%) (p=0.025).

Postoperative Outcomes

The median hospital stay was significantly longer in the ORP group (6 days, IQR: 5-7) than in the LRP group (5 days, IQR: 4-5.8) (p=0.004). Overall complication rates did not differ significantly between the groups (p>0.999). All complications observed in both groups were minor (Clavien-Dindo grade I-II), such as transient fever, and minor wound-related problems. No major complications were recorded in either group. PSM rates (20% ORP vs. 17% LRP, p>0.999), and postoperative pathologic ISUP grade distribution (p=0.329) were similar in both groups. All patients achieved undetectable PSA levels (<0.2 ng/mL) in the early postoperative period. Detectable PSA (>0.2 ng/mL) at 12 months was observed in 10% of patients in both groups, consistent with biochemical recurrence (Table 2).

Functional Outcomes

Postoperative urinary continence outcomes differed significantly between groups: continence (no pad or one safety pad) was achieved in 60% of ORP patients compared with 100% of LRP patients; and incontinence (≥2 pads/day) in 40% vs. 0%, respectively (p<0.001). Recovery of erectile function was observed in 30% of ORP patients and 37% of LRP patients, with no significant difference between the groups (p=0.780) (Table 2).

Table 1. Comparative pre- and perioperative outcomes of ORP and LRP

Variable	ORP (n=30)	LRP (n=30)	p-value
Age, years (mean ± SD)	65±6.3	67.6±7.4	0.212
Preoperative PSA, ng/mL (median, IQR)	7.6 (5.5-9.6)	5.8 (4.6-10.6)	0.25
Prostate volume, mL (median, IQR)	44.5 (24-66)	41 (32-64)	0.968
Digital rectal examination			0.604
Benign	18, 60%	15, 50%	
Malign	12, 40%	15, 50%	
ISUP grade, Bx (n, %)			0.486
1	14, 47%	18, 60%	
2	8, 27%	8, 27%	
3	4, 13%	3, 10%	
4	4, 13%	1, 3%	
5	0	0	
Risk group			0.394
Low	12, 40%	11, 37%	
Intermediate	13, 43%	17, 56%	
High	5, 17%	2, 7%	
Nerve-sparing			0.004
Performed	8, 26.7%	20, 66.7%	
Not performed	22, 73.3%	10, 33.3%	
PLND (n,%)	14, 47%	5, 17%	0.025
Operative time, min (median, IQR)	253 (231-301)	240 (240-270)	0.849
Estimated blood loss, mL (median, IQR)	950 (700-1625)	200 (150-300)	0.001
Intraoperative transfusion (n,%)	18, 60%	0, 0%	<0.001

Chi-square test was used for variables with more than two categories; Fisher's exact test was used for 2×2 categorical variables
ORP: Open radical prostatectomy, LRP: Laparoscopic radical prostatectomy, SD: Standard deviation, IQR: Interquartile range, PSA: Prostate-specific antigen, Bx: Prostate biopsy, ISUP: International Society of Urological Pathology, PLND: Pelvic lymph node dissection

Table 2. Post-operative and functional outcomes

Variable	ORP (n=30)	LRP (n=30)	p-value
Hospital stay, days (median, IQR)	6 (5-7)	5 (4-5.8)	0.004
Overall complication rate (%)	6, 20%	5, 17%	>0.99
ISUP grade, RP (n, %)			0.329
1	3, 10%	5, 17%	
2	18, 60%	16, 53%	
3	6, 20%	3, 10%	
4	3, 10%	3, 10%	
5	0	3, 10%	
Positive surgical margins (%)	6, 20%	5, 17%	>0.99
PSA recurrence (n,%)	3, 10%	3, 10%	>0.99
Continence (n, %)	18, 60%	30, 100%	<0.001
Erectile function recovery (n, %)	9, 30%	11, 37%	0.780

ORP: Open radical prostatectomy, LRP: Laparoscopic radical prostatectomy, SD: Standard deviation, IQR: Interquartile range, PSA: Prostate-specific antigen, RP: Radical prostatectomy, ISUP: International Society of Urological Pathology

Discussion

This study compared the outcomes of open retropubic and LRP performed during the surgeons' initial learning phases. Notably, the surgeon performing the laparoscopic procedures lacked prior experience with ORP, which could have influenced perioperative performance and the progression of the learning curve.

Recent evidence suggests that minimally invasive radical prostatectomy, including laparoscopic and robot-assisted approaches, offers perioperative advantages over open surgery, such as lower estimated blood loss, reduced transfusion requirements, and shorter hospital stays (2,5). A study comparing minimally invasive and open techniques found that minimally invasive approaches were associated with approximately a 83% reduction in transfusion risk and a 1.18-day reduction in hospital stay (2). Although enhanced visualization in minimally invasive surgery may offer technical advantages for functional preservation, the available literature generally suggests that continence outcomes are broadly comparable between minimally invasive and ORP (5,7). In line with these reports, our findings showed that LRP was associated with significantly reduced intraoperative blood loss and transfusion requirements, shorter hospitalization, and improved early continence, while maintaining comparable operative times and oncological outcomes. These results support the existing evidence highlighting the perioperative advantages of minimally invasive techniques, particularly in reducing morbidity and promoting faster recovery.

Radical prostatectomy is a technically challenging procedure that requires delicate dissection because of the complex pelvic anatomy and the need for both functional preservation and oncologic control. Numerous studies have evaluated the learning curve and reported significant variation in the number of cases needed to achieve surgical proficiency. While perioperative parameters such as operative time, complication rates, and hospital stay may improve within the early phase of the learning curve, oncologic and functional outcomes, including continence and surgical margin status, generally require greater surgical experience to stabilize (6,8,9). In their analysis of 4,702 laparoscopic radical prostatectomies, Vickers et al. (3) showed that the risk of recurrence continued to decline with increasing surgical experience, even up to 750 prior cases, indicating a prolonged learning curve for oncologic outcomes. Similarly, Secin et al. (10) reported that the learning curve for PSMs in LRP was prolonged, with improvement continuing up to approximately 200-250 cases, and appeared less rapid than that reported for open surgery.

Despite this challenging learning curve, minimally invasive approaches—even during the early learning period—have demonstrated perioperative advantages, including lower blood loss, reduced transfusion requirements, and shorter hospital stays, while producing comparable oncologic outcomes when performed by experienced surgeons. A meta-analysis by Cao et al. (2) showed that minimally invasive radical prostatectomy, including laparoscopic and robot-assisted approaches significantly reduced blood loss (mean difference ≈749 mL) and transfusion risk (odds ratio ≈0.17) compared with open surgery, with no significant difference between groups in PSMs or biochemical recurrence rates.

Bhayani et al. (11) found that LRP was associated with substantially lower blood loss (533 mL vs. 1,473 mL) and quicker recovery compared with open retropubic prostatectomy, albeit with longer operative time during the initial experience (5.8 hours vs. 2.8 hours). Likewise, a recent randomized clinical study by Guan et al. (12) confirmed that LRP achieved less intraoperative bleeding, shorter hospitalization, faster recovery, and better early continence than open surgery in localized prostate cancer. In our series, despite the surgeons being in their early learning phase, LRP showed clear perioperative benefits over open surgery-markedly lower intraoperative blood loss (~200 mL vs. ~950 mL), no transfusions, and shorter hospital stay. The relatively high transfusion rate in the ORP group should be interpreted in light of transfusion decisions being based on intraoperative clinical judgment rather than on a predefined blood-loss cut-off. Additionally, since these cases were performed during the surgeon's initial learning phase, a lower threshold for transfusion may have been adopted for some patients to improve perioperative safety. Early recovery of urinary continence was also superior in the LRP group. Our results are consistent with previous studies showing that LRP can reduce perioperative morbidity without compromising oncological safety.

The superiority of LRP in these aspects stems from several technical and physiological advantages inherent to the minimally invasive approach. These perioperative advantages may be partly explained by the magnified operative view and the tamponade effect of pneumoperitoneum, which can facilitate dissection and hemostasis (13,14). Minimal access reduces wound trauma, postoperative pain, and systemic inflammatory response, resulting in earlier mobilization and shorter hospitalization. Moreover, enhanced magnification may facilitate more precise preservation of periurethral and sphincteric structures, which could contribute to functional recovery (15). More broadly, when performed by adequately trained surgeons, the perioperative advantages of LRP may be achieved without a clear compromise in oncologic outcomes, as comparative studies have generally reported comparable PSM and biochemical recurrence results between minimally invasive and open techniques (5,16).

In our study, PLND was performed significantly less often in the LRP group than in the ORP group. Although differences in preoperative risk distribution may have contributed to this imbalance, the discrepancy cannot be explained solely by risk stratification. It is also likely to reflect surgeon- and technique-related factors during the early learning phase, including the greater technical complexity of laparoscopic PLND, limited tactile feedback, restricted instrument mobility, and a tendency to avoid more demanding adjunctive procedures during that phase. Therefore, the lower PLND rate in the LRP group should be interpreted as multifactorial rather than as a difference solely attributable to the patient risk profile. Similar patterns have been reported in early laparoscopic series. In the large series by Stolzenburg et al. (17), pelvic lymph node dissection was not performed in all patients. Similarly, the prolonged learning curve reported for LRP may indirectly reflect the technical burden of the procedure during early experience; however, this evidence does not specifically address PLND rates (10). Therefore, the lower PLND rate in our LRP cohort most likely represents a learning-phase phenomenon rather than an inherent limitation of the minimally invasive technique. This difference should also be taken into account when interpreting perioperative outcomes, as the lower PLND rate in the LRP group may have contributed, at least in part, to the observed differences in blood loss, transfusion requirements, operative time, and complication profiles.

In our cohort, postoperative recovery of erectile function was similar in the open and laparoscopic groups (30% vs. 37%, p=0.78). Although the difference did not reach statistical significance, the slightly higher rate observed in the LRP group may be attributable to improved dissection of the neurovascular bundles achieved with laparoscopic magnification. Stolzenburg et al. (17) reported that the magnified laparoscopic view and improved hemostasis may facilitate more precise identification and preservation of the neurovascular bundles in selected patients, which may support postoperative sexual function recovery.

Compared with conventional laparoscopy, robotic surgery may facilitate adoption because of wristed instrumentation, three-dimensional visualization, and improved ergonomics; however, reported learning-curve estimates vary substantially depending on the outcome assessed (15,18). However, particularly in resource-limited settings, use of robot-assisted radical prostatectomy remains limited for several reasons. Beyond the high installation and ongoing maintenance costs of robotic systems, limited access to training and a shortage of experienced robotic surgeons—particularly in developing or resource-limited healthcare settings—continue to be major obstacles (19,20). Therefore, in regions where robotic technology remains inaccessible or financially impractical, conventional LRP continues to play a crucial role as a safe, effective, and sustainable treatment option. Consistent with these observations, our findings further support the clinical feasibility and safety of LRP as a durable, minimally invasive alternative in resource-limited settings.

Study Limitations

The retrospective design and single-center setting of our study may have introduced selection bias, limiting the generalizability of the results. The small sample size made it difficult to demonstrate small differences statistically, particularly in functional and oncologic outcomes. Due to the limited follow-up period, long-term continence, potency, and oncologic control could not be assessed. Moreover, both surgeons were at the beginning of their respective learning curves. Therefore, it is difficult to distinguish outcomes related to the intrinsic characteristics of the surgical technique from those associated with the surgeon's level of proficiency, which may have been an important confounding factor in comparisons between groups. Another important limitation is that urinary continence and erectile function outcomes were based on patients' self-reports rather than on validated questionnaires or objective assessment tools, which may have introduced reporting and recall biases. In addition, the significant difference in PLND rates between the groups may have acted as a confounding factor, as it may have affected perioperative outcomes, including blood loss, transfusion requirements, operative time, and complications. Despite these limitations, we believe that this study makes a significant contribution to the feasibility and safety of LRP in patients with no prior experience of open surgery, especially in clinics with limited access to robotic technology.

With appropriate training and structured mentorship, safe and reproducible outcomes can be achieved in radical prostatectomy, even during the surgeon's early experience. The literature suggests that early LRP experience supported by structured mentorship may provide acceptable perioperative and functional outcomes during the initial learning phase, while large high-volume series have shown that favorable outcomes can be achieved with increasing experience (9,14). However, prior experience with basic laparoscopic urogenital procedures may facilitate the transition to more complex operations, such as LRP (21). Therefore, our findings support the notion that under proper supervision and after sufficient laparoscopic experience, surgeons completing urology residency may safely begin their learning curve in performing LRP.

Conclusion

This retrospective analysis indicates that LRP provides superior perioperative outcomes, including reduced blood loss, fewer transfusions, shorter hospital stays, and improved early urinary continence. Moreover, it maintains early oncologic safety compared with ORP, even during the initial learning curve. Larger prospective studies are necessary to confirm these findings and to further assess long-term functional and oncological results.

Ethics

Ethics Committee Approval: The study was approved by Marmara University School of Medicine Non-Drug and Non-Medical Device Research Ethics Committee (approval number: 09.2025.25-0501, date: 20.06.2025).

Informed Consent: Written informed consent was obtained from all participants.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Y.Ş., M.K., Concept: Y.Ş., M.K., G.Ö., K.Ç., Design: Y.Ş., A.V.B., K.Ç., Data Collection or Processing: A.V.B., G.Ö., Analysis or Interpretation: A.V.B., G.Ö., Literature Search: A.V.B., Writing: Y.Ş., M.K., K.Ç.

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References

1. Cornford P, van den Bergh RCN, Briers E, Chiu P, Eberli D, Epure A, Farolfi A, Fonteyne V, Gandaglia G, Gillessen S, Grivas N, Henry AM, van Leenders GJLH, Espinos EL, Matsen B, Oldenburg J, van Oort IM, Oprea-Lager DE, Roberts MJ, Rouvière O, Sachdeva A, Santis M, Schoots IG, Smith EJ, Stranne J, Wiegel T, Tilki D. EAU-EANM-ESTRO-ESUR-ISUP-SIOG guidelines on prostate cancer-2026 update. Part I: screening, diagnosis, and local treatment with curative intent. Eur Urol. 2026:S0302-2838(26)02114-7. [Crossref]
2. Cao L, Yang Z, Qi L, Chen M. Robot-assisted and laparoscopic vs open radical prostatectomy in clinically localized prostate cancer: perioperative, functional, and oncological outcomes: a systematic review and meta-analysis. Medicine (Baltimore). 2019;98:e15770. [Crossref]
3. Vickers AJ, Savage CJ, Hruza M, Tuerk I, Koenig P, Martínez-Piñeiro L, Janetschek G, Guillonneau B. The surgical learning curve for laparoscopic radical prostatectomy: a retrospective cohort study. Lancet Oncol. 2009;10:475-480. [Crossref]
4. von Ahlen C, Geissler A, Vogel J. Comparison of the effectiveness of open, laparoscopic, and robotic-assisted radical prostatectomies based on complication rates: a retrospective observational study with administrative data from Switzerland. BMC Urol. 2024;24:215. [Crossref]
5. Matalani CFA, Costa MSS, Rocha MRD, Lopes RI, Talizin TB, Bessa Júnior J, Nahas WC, Ribeiro-Filho LA, Suartz CV. Minimally invasive radical prostatectomy versus open radical prostatectomy: a systematic review and meta-analysis of randomized control trials. Clinics (Sao Paulo). 2025;80:100636. [Crossref]
6. Ficarra V, Novara G, Artibani W, Cestari A, Galfano A, Graefen M, Guazzoni G, Guillonneau B, Menon M, Montorsi F, Patel V, Rassweiler J, Van Poppel H. Retropubic, laparoscopic, and robot-assisted radical prostatectomy: a systematic review and cumulative analysis of comparative studies. Eur Urol. 2009;55:1037-1063. [Crossref]
7. Roumeguere T, Bollens R, Vanden Bossche M, Rochet D, Bialek D, Hoffman P, Quackels T, Damoun A, Wespes E, Schulman CC, Zlotta AR. Radical prostatectomy: a prospective comparison of oncological and functional results between open and laparoscopic approaches. World J Urol. 2003;20:360-366. [Crossref]
8. Barnaś A, Milecki T, Ida A, Kasperczak M, Lipski A, Antczak A, Cieślikowski WA. Learning curve for laparoscopic radical prostatectomy. Wideochir Inne Tech Maloinwazyjne. 2025;20:69-75. [Crossref]
9. Fabrizio MD, Tuerk I, Schellhammer PF. Laparoscopic radical prostatectomy: decreasing the learning curve using a mentor initiated approach. J Urol. 2003;169:2063-2065. [Crossref]
10. Secin FP, Savage C, Abbou C, de La Taille A, Salomon L, Rassweiler J, Hruza M, Rozet F, Cathelineau X, Janetschek G, Nassar F, Turk I, Vanni AJ, Gill IS, Koenig P, Kaouk JH, Martinez Pineiro L, Pansadoro V, Emiliozzi P, Bjartell A, Jiborn T, Eden C, Richards AJ, Van Velthoven R, Stolzenburg JU, Rabenalt R, Su LM, Pavlovich CP, Levinson AW, Touijer KA, Vickers A, Guillonneau B. The learning curve for laparoscopic radical prostatectomy: an international multicenter study. J Urol. 2010;184:2291-2296. [Crossref]
11. Bhayani SB, Pavlovich CP, Hsu TS, Sullivan W, Su Li. Prospective comparison of short-term convalescence: laparoscopic radical prostatectomy versus open radical retropubic prostatectomy. Urology. 2003;61:612-616. [Crossref]
12. Guan Y, Tan C, Zhu H, Li H, Liu H, Hu W, Song H, Xiao F. Clinical effects of laparoscopic versus open radical prostatectomy in the treatment of early prostate cancer. Afr J Reprod Health. 2025;29:106-112. [Crossref]
13. Jo SB, Kim JW. Recent advances in radical prostatectomy: a narrative review of surgical ınnovations and outcomes. Cancers (Basel). 2025;17:902. [Crossref]
14. Stolzenburg JU, Rabenalt R, Do M, Kallidonis P, Liatsikos EN. Endoscopic extraperitoneal radical prostatectomy: the University of Leipzig experience of 2000 cases. J Endourol. 2008;22:2319-2325. [Crossref]
15. Lau HM, Qu LG, Woon DTS. Advances in techniques in radical prostatectomy. Medicina (Kaunas). 2025;61:1222. [Crossref]
16. Kim DK, Moon YJ, Chung DY, Jung HD, Jeon SH, Kang SH, Paick S, Lee JY; Korean Society of Endourology and Robotics (KSER) Research Committee. Comparison of robot-assisted, laparoscopic, and open radical prostatectomy outcomes: a systematic review and network meta-analysis from KSER update series. Medicina (Kaunas). 2025;61:61. [Crossref]
17. Stolzenburg JU, Rabenalt R, DO M, Ho K, Dorschner W, Waldkirch E, Jonas U, Schütz A, Horn L, Truss MC. Endoscopic extraperitoneal radical prostatectomy: oncological and functional results after 700 procedures. J Urol. 2005;174:1271-1275; discussion 1275. [Crossref]
18. Tokas T, Mavridis C, Bouchalakis A, Nakou CM, Mamoulakis C. Learning curves in robotic urological oncological surgery: has anything changed during the last five years? Cancers (Basel). 2025;17:1334. [Crossref]
19. Barbash GI, Glied SA. New technology and health care costs--the case of robot-assisted surgery. N Engl J Med. 2010;363:701-704. [Crossref]
20. Falola AF, Singh S, Das U, Oluwagbemi A, Etta R, Adeyeye A. Barriers and recommendations for the implementation of robot-assisted minimally invasive surgery in Africa. J Robot Surg. 2024;19:16. [Crossref]
21. Bollens R, Sandhu S, Roumeguere T, Quackels T, Schulman C. Laparoscopic radical prostatectomy: the learning curve. Curr Opin Urol. 2005;15:79-82. [Crossref]