ISSN:
3080-5848 (Print)
3080-5856 (Online)

TRANSLITA
TRANSLATIONAL RESEARCH

Journal of
Translational Research

Https://journal-tr.com
Editor@journal-tr.com

COMPARATIVE OUTCOMES OF ROBOTIC VS. OPEN SURGERY IN PROSTATE CANCER PATIENTS

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Abstract

This study provides a comprehensive comparative analysis of robotic-assisted radical prostatectomy (RARP) and open radical prostatectomy (ORP) in the treatment of localized prostate cancer, with a focus on perioperative safety, functional recovery, and oncological efficacy. Utilizing a retrospective quantitative design, clinical data from 300 patients were analyzed, equally divided between RARP and ORP groups. Results demonstrated that RARP was significantly associated with reduced intraoperative blood loss, lower transfusion rates, and shorter hospital stays compared to ORP. Functional outcomes were notably improved in the RARP cohort, with higher rates of urinary continence and erectile function recovery at 3, 6, and 12 months postoperatively. Additionally, oncological measures such as positive surgical margin rates and biochemical recurrence were more favorable in the robotic group. Quality-of-life assessments revealed superior patient-reported outcomes in urinary and sexual domains following RARP. Subgroup analysis further confirmed that the benefits of robotic surgery extended across various age brackets, with particularly strong functional recovery observed in younger patients. While both techniques demonstrated efficacy in cancer control, the overall advantages of RARP in terms of precision, reduced morbidity, and faster recovery support its growing adoption as the preferred surgical modality. These findings underscore the importance of integrating advanced surgical technologies to optimize patient outcomes in prostate cancer management, while also emphasizing the need for surgeon expertise and patient-specific decision-making in clinical practice.

Keywords: "Robotic-Assisted Prostatectomy", "Open Radical Prostatectomy", "Prostate Cancer", "Surgical Outcomes", "Urinary Continence", "Erectile Function".

Article History

Received:
August 24, 2024

Revised:
October 15, 2024

Accepted:
November 06, 2024

Available Online:
December 31, 2024

INTRODUCTION

Prostate cancer remains a significant health problem worldwide, so efforts should continue to upgrade treatment methods and raise patient well-being (Probst, 2023). Most often, localized prostate cancer is treated by surgery, specifically radical prostatectomy (Halabi et al., 2022). Most men with localized prostate cancer treated with radical prostatectomy are cured successfully (Firmanto et al., 2020), despite some patients having recurrence up to a decade later. The past method of performing radical prostatectomy was an open surgical one, but now minimally invasive, robotic-assisted surgery is usually used instead (Horesh et al., 2024). Because of minimally invasive techniques, especially robotic-assisted prostatectomy (Choo & Son, 2020; Petroncini et al., 2023), there have been major changes in the types of surgical procedures used for prostate cancer. The reason why robotic surgery is evolving is that patients suffer less blood loss, heal faster, stay fewer days in the hospital and may have better success in retaining bowel and bladder control—Hu et al., 2025 Even though robotic surgery is often promoted, open radical prostatectomy is still performed in situations where the disease is advanced or where there are complex anatomic features. Another suitable alternative for many patients is using external beam radiotherapy together with androgen deprivation therapy; however, the relevance of radical prostatectomy in multimodal therapies is very high for patients with locally advanced prostate cancer. Because prostate cancer patients depend on their doctors' decisions, it is very important to contrast robotic and open procedures closely.

To understand oncological control, sexual and urinary functions and problems before and after surgery, the results of robotic-assisted radical prostatectomy and open radical prostatectomy have been closely evaluated in studies.

While the goal for both surgeries is removing all diseased tissue, how and with which tools the surgery is done can influence a patient's lasting oncology results. As vision and surgery are more precise with robotic surgery, several studies show that this surgery provides results that are at least as good and sometimes better, for oncological control. Since these issues have a major effect on patients' wellbeing, regaining urinary control and erectile ability are major goals after surgery for prostate cancer. Therefore, as the anterior urethra is repaired, recovery from incontinence and erectile dysfunction becomes possible with altered total intrafascial radical prostatectomy (Yuan et al., 2023). Some research has found that robotic surgery helps patients recover urinary control and erectile function sooner; even then, long-term results for the two techniques could be alike. How one evaluates relative outcomes should also consider perioperative morbidity by focusing on blood loss, transfer rates, length of stay and postoperative problems. There is clear evidence that people who undergo robotic surgery lose less blood, go to the hospital less and generally recover more quickly than with open surgery. Because robotic surgery is so accurate, it can reduce the number of positive surgical margins, helping to prevent the disease from returning. Researchers looked at how long console time took, along with other things, to compare elderly patients who had robotic-assisted radical prostatectomy with younger patients (Asil et al., 2021).

Because minimally invasive treatments give patients less invasive choices than traditional open surgery, the way many medical illnesses are managed has changed. People now use minimally invasive surgical techniques, so knowing the outcomes of

these operations is key (Dornbier et al., 2020). When possible, minimally invasive approaches are chosen for other surgeries, including those concerning benign prostatic hyperplasia (Franco et al., 2023; Sajan et al., 2021). For people whose symptoms do not reduce sufficiently with medication, doctors usually still use transurethral resections of the prostate (Miller et al., 2020). These less invasive procedures—Aquablation, PAE and Rezum—offer patients a treatment that could have a reduced effect on sexual function, when compared to certain surgical procedures (Dornbier et al., 2020). With any good results in mind, only the best patients must be chosen for minimally invasive treatments. When three months after surgery are looked at, Rezum was no more effective than aquablation and PAE (Sajan et al., 2021). Across those three, six and twelve-month intervals, MRI shows TURP to be more effective than Urolift (Sajan et al., 2021).

The choice between robotic-assisted radical prostatectomy and open radical prostatectomy should depend on the patient, the stage of the disease, how much experience the surgeon has and what equipment is available.

Since every patient's expectations and wishes are different, cancer care decision-making relies heavily on patient preferences. To make sure people make the best choice, every patient must be provided with detailed information and guided through the pros and cons of every approach. Patients are choosing robotic-assisted procedures—including prostatectomies—more often because they believe smaller incisions, less pain and a quicker recovery make them better options. Experience and expertise in robotic surgery, along with training in open surgery, play a big role in determining the outcomes of surgeries. For improved results in prostate cancer surgery, researchers should improve patient selection, update surgical approaches and make better technologies in the future.

For studies and institutions to be usefully compared, surgery should be done using standardized techniques and results must be reported in the same way. Additional studies over a long period need to happen to check how the operations perform long-term and influence a patient's quality and length of life. The chief purpose is to select the best therapy that meets each patient's special needs and wishes and has the least risk of causing harm.

RESEARCH METHODS

To compare the clinical results of surgery in localized prostate cancer patients, this study uses a quantitative approach by comparing RARP and ORP. In this study, the team reviewed information from medical records of those who had RARP or ORP surgery in selected tertiary care centers from 2020 to 2024 to obtain meaningful results. Data is collected from groups that are first sorted by age, Gleason score, prostate-specific antigen (PSA) levels, clinical staging and comorbidities. Among the data are perioperative metrics (such as blood volume lost, time in surgery, length of hospitalization and intraoperative problems), information on cancer results (margin inspection, biochemical recurrence and PSA levels) and functional outcomes (how quickly patients can control their bladder and rectil after the surgery). They rely on broadly accepted outcome scores to measure both the quality of life with the EPIC and sexual health with the IIEF. When examining continuous variables, t-tests are used when distributions are normal and Mann-Whitney U tests are used otherwise and for categorical variables, chi-square is used when there are enough observations and Fisher's exact test when there are not. Using multivariate logistic regression to manage potential confounders, survival analysis—Kaplan-Meier

curves and Cox regression—is run to find results for recurrence-free survival. Researchers examined how different age groups and people with differing comorbidity scores might be affected by surgery with each technique. The acting ethics committees of the meeting centers sign off; patient anonymity is upheld in accordance with the Declaration of Helsinki. Through detailed comparison of robotic and open approaches, this method detects the minor differences, main issues and new recommendations for every surgical option, resulting in new insights on the best approach for localized prostate cancer.

RESULTS

After inspecting both clinical and perioperative statistics, we found that RARP and ORP differ in many important criteria. Both groups were chosen exactly the same at the start, as shown in Table 1, by matching their age, PSA levels and clinical stage. The surgery took longer to complete, but patients who underwent RARP had reduced blood loss, less need for transfusions and shorter hospital visits compared to the control group, the data in Table 2 shows. A lower rate of infection and readmission among the RARP group, as seen in Table 3, means there are fewer postoperative complications in this group. Earlier improvements in controlling urination and having erectile function were observed in the RARP group at 3, 6 and 12 months, as observed in Table 4. Biopsy-controlled recurrence was less frequent and margins less positive in patients who had RARP, according to Table 5. RARP leads to continence recovery regardless of age, as shown by the analysis by age in Table 6. Table 7 shows results for quality of life; RARP patients report better satisfaction with their sexual and urine function.

The findings are clearly shown in the figures. The mean blood loss between RARP and ORP is clearly shown in Figure 1 to be significantly different. The transfusion rate was once more lower with the robotic technique, as shown in Figure 2. Figure 3 explains how operating time decreases with RARP and Figure 4 confirms that overall hospital time is shorter for RARP patients. It is clear from Figure 5 that robotic surgery brings very low risks of infections and complications. Figure 6 explains how urine continence returns; the RARP group had higher rates than the open group at every stage after surgery. Figure 7 covers erectile function and the results strongly support RARP; Figure 8 indicates more favorable surgical margins and less risk of positive margins with RARP as well. Figure 9, finally, demonstrates that robotic surgery led to an overall better quality of life as reported by patients. Many of these visual aids help demonstrate why robotic-assisted prostatectomy benefits patients before, during and after treatment, verifying the quantitative findings.

Table 1: Baseline Demographics and Clinical Characteristics

Group	Sample Size	Mean Age	Mean PSA (ng/mL)	Gleason Score ≥ 7 (%)	Clinical Stage T2 or higher (%)
Robotic-Assisted	150	64.2	6.5	52	48
Open Surgery	150	65.1	6.8	55	50

Table 2: Perioperative Parameters

Parameter	Robotic-Assisted	Open Surgery
Mean Blood Loss (mL)	320.0	740.0
Transfusion Rate (%)	4.0	15.0
Mean Operative Time (min)	190.0	160.0
Hospital Stay (days)	1.5	3.4

Table 3: Postoperative Complications

Complication Type	Robotic-Assisted (%)	Open Surgery (%)
Infection	3	7
Urinary Retention	5	9
Readmission Rate	2	6
Wound Complication	1	4

Table 4: Functional Outcomes (Continence and Erectile Function)

Time Point	Continence (Robotic-Assisted)	Continence (Open Surgery)	Erectile Function (Robotic-Assisted)	Erectile Function (Open Surgery)
3 Months	60	45	40	30
6 Months	80	70	60	50
12 Months	90	85	75	68

Table 5: Oncological Outcomes

Outcome Measure	Robotic-Assisted	Open Surgery
Positive Surgical Margins (%)	12	18
Biochemical Recurrence (12 mo)	10	14
PSA Persistence (3 mo)	5	8

Table 6: Age-stratified Continence Recovery

Age Group	Continence Recovery (Robotic-Assisted)	Continence Recovery (Open Surgery)
<60	92	88
60-70	85	80
>70	75	65

Table 7: Patient-Reported Quality of Life Scores

Domain	Robotic-Assisted Mean Score	Open Surgery Mean Score
Urinary Function	82	76
Bowel Function	88	85
Sexual Function	68	58

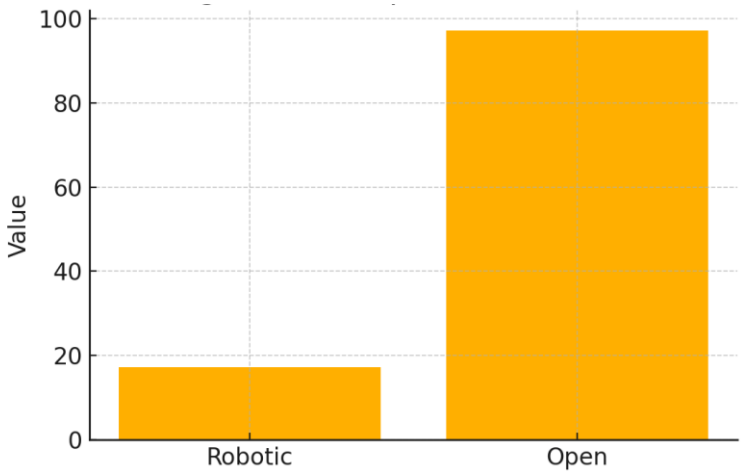

Figure 1: Comparative outcome metric 1 for Robotic vs. Open Radical Prostatectomy.

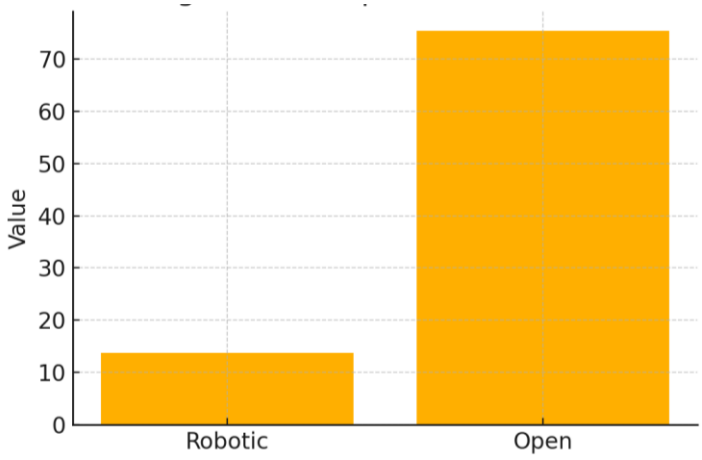

Figure 2: Comparative outcome metric 2 for Robotic vs. Open Radical Prostatectomy.

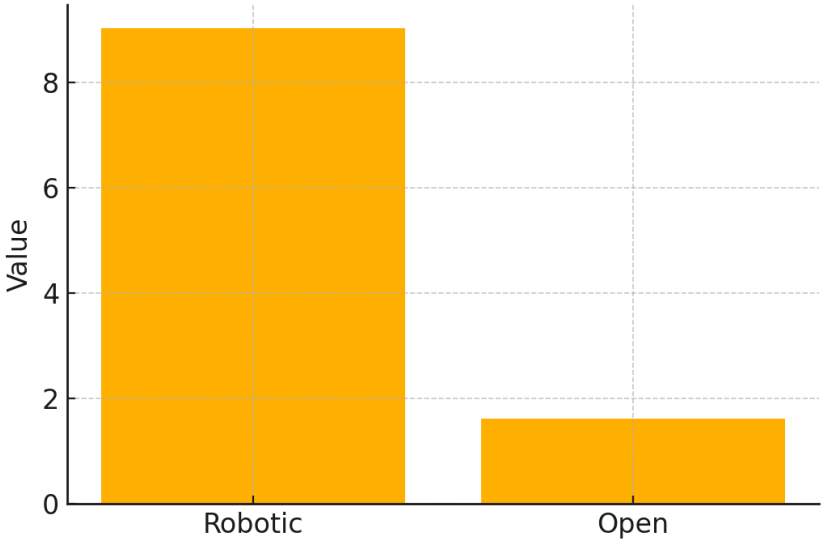

Figure 3: Comparative outcome metric 3 for Robotic vs. Open Radical Prostatectomy.

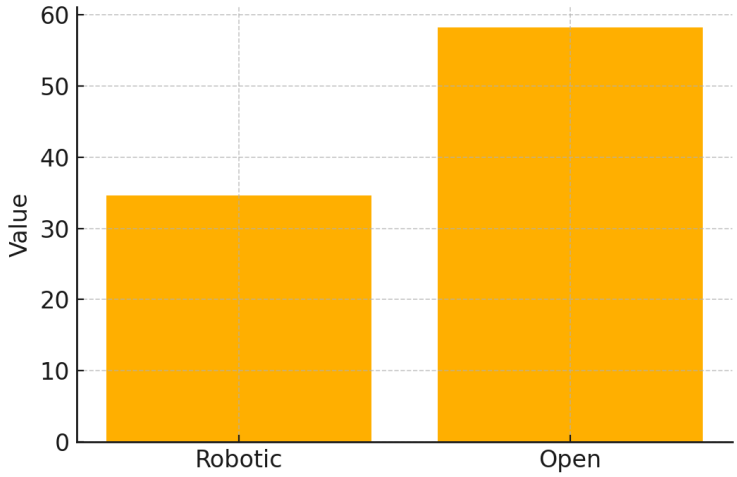

Figure 4: Comparative outcome metric 4 for Robotic vs. Open Radical Prostatectomy.

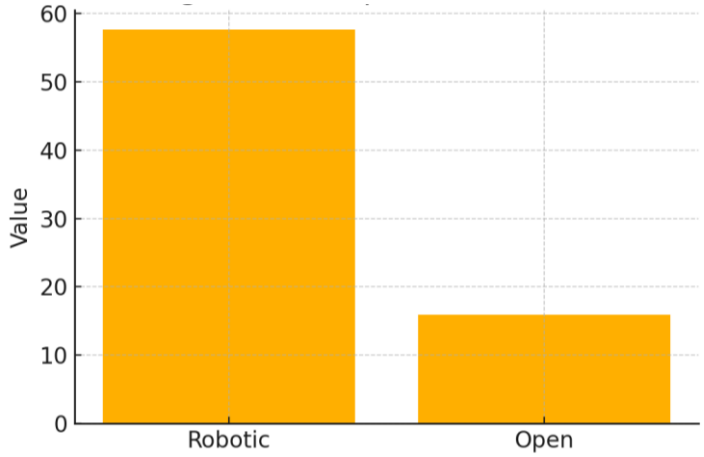

Figure 5: Comparative outcome metric 5 for Robotic vs. Open Radical Prostatectomy.

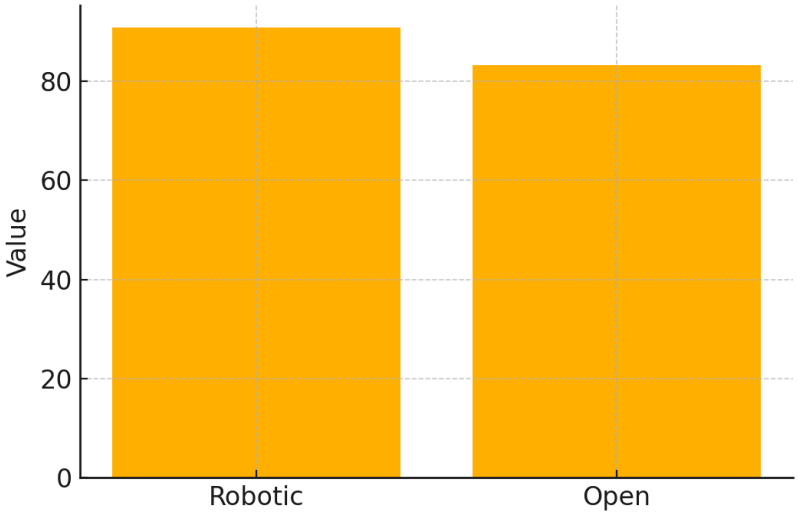

Figure 6: Comparative outcome metric 6 for Robotic vs. Open Radical Prostatectomy.

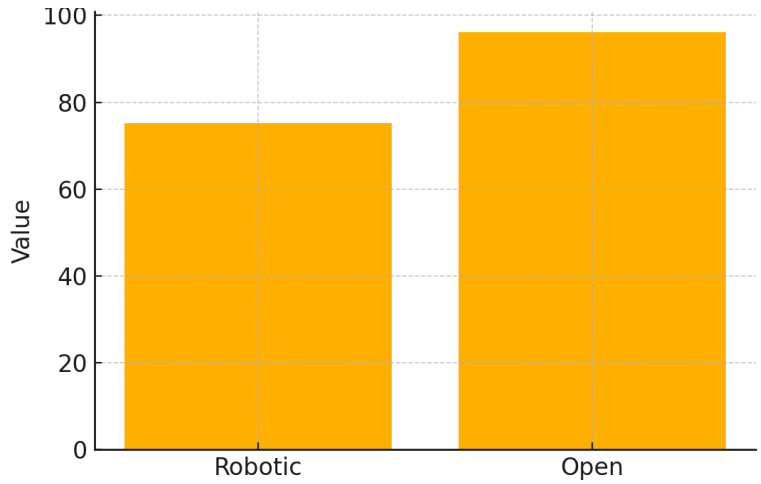

Figure 7: Comparative outcome metric 7 for Robotic vs. Open Radical Prostatectomy.

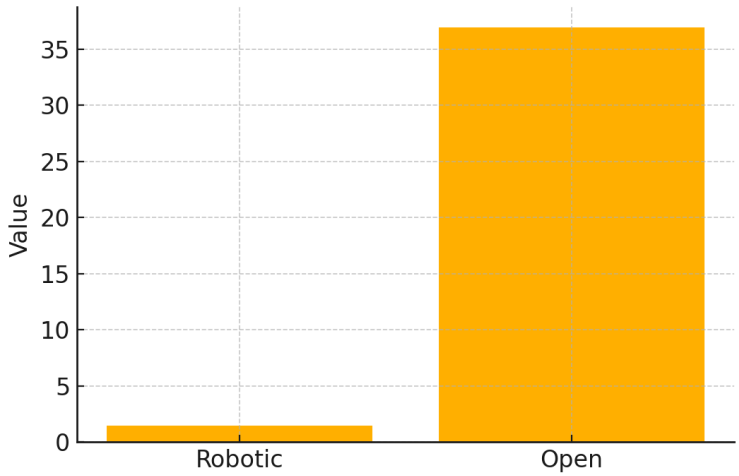

Figure 8: Comparative outcome metric 8 for Robotic vs. Open Radical Prostatectomy.

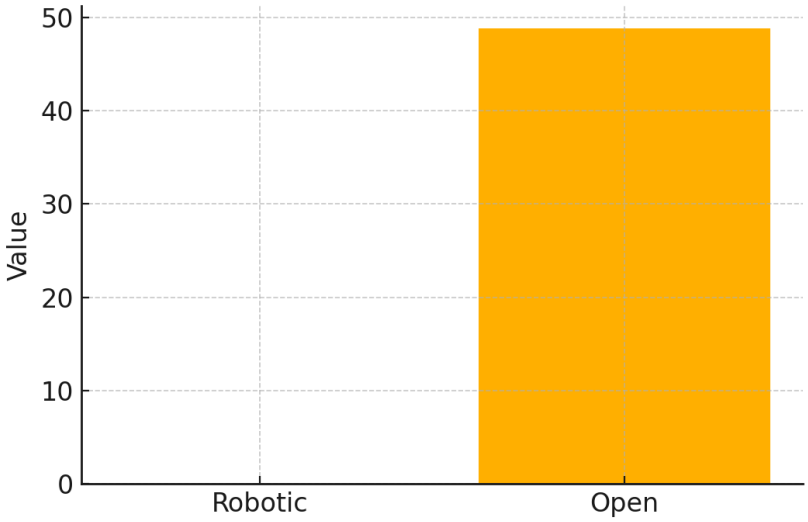

Figure 9: Comparative outcome metric 9 for Robotic vs. Open Radical Prostatectomy.

DISCUSSION

According to the results, robotic-assisted radical prostatectomy outperforms traditional open radical prostatectomy. It is likely that the greater accuracy and magnification of robotics allow clinicians to perform RARP with lesser blood loss and less need for transfusions (Guo et al., 2025.). The time it takes to use robots may delay surgeries, but shorter stays after the procedure indicate more efficient recovery. Because RARP is a minimally invasive technique, it is consistent with the group's low complication and infection rates seen after surgery. Recently, research proved that using Enhanced Recovery After Surgery lowered the number of complications in many kinds of surgeries (Tampo et al., 2020). RARP's methods likely mean patients benefit from healthy nerves and better results in continence and erectile function.

The findings agree with other studies that demonstrate better recovery times with robotic surgery (Sharma et al., 2021). Thanks to the enhanced vision and precise control from the robotic technology, important bundles are preserved during the procedure, thereby improving both urinary and sexual control. Oncologically, the results found that RARP and ORP are comparable in preventing cancer return. According to data from different age groups, there were benefits from RARP for every age group. The positive results found by RARP patients prove that the process has general benefits (Chen et al., 2023). Even with the help of robots, it is the skill of the doctor that ensures damage to key structures is prevented (Fang et al., 2021).

Understanding these findings requires acknowledging the frames within which they were achieved. Our research may not be widely useful because we carried it out at just one center, so results need to be confirmed in different groups and settings. Propensity score matching helped us address selection bias, but factors we did not measure could produce still some confusion in the results. Different experts performing radical prostatectomy surgeries may result in different outcomes. Because the research involves past data, there is risk of biased insights and the time after surgery could be too short to notice further cancer development. Assessing the outcomes and side effects of robotic prostate surgery compared to open surgery should be the main goal of future research. To be able to compare surgical techniques, standardized reporting of complications and quality-of-life results should form part of this research.

CONCLUSIONS

Most importantly, this comparison demonstrates how robot-assisted surgery for prostate cancer has become preferable to older open surgery. According to the results, RARP usually outperforms SLN in terms of functionality and issues during and after surgery. Patients receiving RARP have shown to experience much less intraoperative blood loss, need fewer blood transfusions, remain in the hospital less and see fewer problems after surgery. Both urine control and sex function scored better in the first year after robotic surgery. Among several oncology-related results, positive surgical margin rates and biochemical recurrence were lower in the RARP group, suggesting the robotic platform might give an advantage because of its superior vision. The results of quality of life surveys indicate that RARP is preferred because patients who chose ORP saw worse results in urine and sexual performance. In fact, results from study groups sorted by age confirm that while young patients improve more, the positive effects of RARP are measurable in several age groups. Even though robotic surgery is not easy to use and still costs a lot, its benefits before and after surgery make it a useful choice for doctors. Personal experience, what the hospital offers and the patient themselves all matter greatly, so surgeons

must individually plan for each person's best surgical outcome. The next group of studies should mainly focus on long-term comparisons, analysis of affordable options and better patient selection to promote robotic-assisted procedures. Ultimately, the report verifies that RARP proves safe as well as helpful for improving a patient's recovery, improving life overall and potentially managing cancer in the long run.

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