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A comparative study of robot-assisted and open radical prostatectomy in 10 790 men treated by highly trained surgeons for both procedures

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Objective

To compare oncological, functional and surgical outcomes of open retropubic radical prostatectomy (ORP) vs robot-assisted laparoscopic radical prostatectomy (RARP).

Patients and methods

We identified 10 790 consecutive treated patients within our prospective database (2008–2016) who underwent either ORP (7007 patients) or RARP (3783). All procedures were performed by seven highly trained surgeons performing both surgical approaches regularly. Oncological (48-month biochemical recurrence [BCR] rate), functional (urinary continence, erectile function), and surgical outcomes (rate of nerve-sparing [NS] procedures, lymph node yield, surgical margin [SM] status, length of hospital stay [LOS], operation time, blood loss, transfusion rate, time to catheter removal) were assessed. Kaplan–Meier, multivariable Cox and logistic regression models were used to test for BCR and functional outcome differences.

Results

No statistically significant difference regarding oncological outcome distinguished between ORP vs RARP. For functional outcomes, the 1-week continence rates were higher in the ORP group (25.8% vs 21.8%, $P < 0.001$). At 3 months, no statistically significant differences were observed. At 12 months, continence rates were modestly higher in the RARP group (90.3% vs 88.8%, $P = 0.01$). This effect was no longer observed after stratification for age-groups. The 12-month potency rates were similar in ORP vs RARP (80.3% vs 83.6%, $P = 0.33$). For surgical outcomes, there was no significant difference in the rates of NS procedures, lymph node yield, SM status, and LOS. Conversely, operation time was shorter in ORP, and blood loss, transfusion rates and time to catheter removal were significantly lower in RARP.

Conclusions

Both surgical approaches, performed in a high-volume centre by the same surgeons, achieve excellent, comparable oncological and functional outcomes. However, a modest advantage for RARP for surgical outcomes was observed, most likely attributable to its minimally invasive nature, and better teaching capabilities. Consequently, more than the surgical approach itself, the well-trained surgeon remains the most important factor to achieve satisfactory outcomes.

Keywords

prostate cancer, survival outcomes, functional outcomes, surgical outcomes

Introduction

Prostate cancer is one of the most common male malignancies in the Western world. Radical prostatectomy (RP) represents one of the most frequently used treatment options in localised prostate cancer, usually performed as either retropubic open RP (ORP) or robot-assisted RP (RARP). Since its introduction almost 20 years ago, RARP has evolved into the predominant surgical approach in many industrialised countries [1], leading to the favourable development of centralisation and creation of high-volume centres [2]. However, reliable data on comparisons of the two surgical approaches are scarce. Specifically, publications either originate from centres or surgeons favouring one approach or are derived from meta-analyses that summarise these studies [3–6]. Moreover, once a robotic system is installed, the open approach is usually abandoned, such that more historical ORP results are compared with more contemporary RARP results [4]. Consequently, the comparison of ORP vs RARP still remains inconclusive.

Based on these considerations, we analysed the oncological, functional and surgical outcomes of ORP vs RARP in the unique context of a very-high-volume centre with highly trained surgeons performing both surgical approaches routinely and similarly. We aimed to provide a more conclusive and comprehensive analysis of both surgical approaches.

Patients and methods

Study population

Within our prospectively collected Institutional Review Board-approved database, we identified 10 790 consecutive patients who underwent either ORP (7007 patients) or RARP (3783) between 2008 and 2016. All procedures were performed by seven highly trained surgeons performing both surgical approaches regularly. Six of them were initially novice robotic surgeons but had previously performed a mean (median; range) of 1076 (1007; 21–2515) ORPs. They were institutionally trained by the most experienced robotic surgeon. To reduce a potential learning curve bias, the first 100 RARPs of each surgeon were excluded from the analyses, as previously described [5]. This resulted in a mean (median; range) robotic experience of 474 (352; 1–1593) RARPs.

To optimise urinary continence, the full functional-length urethral sphincter preservation technique was performed [7]. In case of erectile nerve sparing (NS), neurovascular structure-adjacent frozen-section examination (NeuroSAFE) was applied [8]. This allows real-time histological monitoring of the oncological safety of NS to avoid positive surgical margins (SMs).

For follow-up assessment, patient-reported outcomes prospectively collected in our institutional database were assessed using standardised, self-administrated questionnaires evaluating urinary continence and erectile function (EF).

Outcomes

Oncological (48-month biochemical recurrence [BCR] rate), functional (urinary continence and EF) and surgical (rate of NS procedures, lymph node yield, SM status, length of hospital stay [LOS], operation time, blood loss, transfusion rate and time to catheter removal) outcomes were assessed.

BCR was defined as a postoperative PSA level ≥0.2 ng/mL. Postoperative urinary continence was defined by number of pads used per day. Urinary continence rates were evaluated at 1 week, and 3 and 12 months after surgery. At 1 week after catheter removal, pad use was categorised as 0, 1, 2 or ≥3 pads/day. At 3 and 12 months after surgery, pad use was categorised as 0 or 1 (for safety reasons only), 1–2 or ≥3pads/day.

EF was defined by a five-item version of the International index of erectile function (IIEF-5) score of ≥18 [9]. For evaluation of postsurgical EF, we relied on preoperatively potent patients (IIEF-5 score ≥18) and assessed how many patients achieved an assisted or unassisted IIEF-5-score of ≥18 postoperatively. Moreover, we assessed the percentage of patients who achieved a score of ≥2/5 points at question number two of the IIEF-5 (‘when you had erections with sexual stimulation, how often were your erections hard enough for penetration’).

Statistical analyses

Descriptive statistics included frequencies and proportions for categorical variables. Means, medians, and ranges were reported for continuously coded variables. The chi-squared tested the statistical significance in proportions differences. The *t*-test and Wilcoxon test examined the statistical significance of means and median differences.

For assessment of BCR-free survival rates, we relied on propensity score (PS) matching (3:1) for year of surgery (continuously coded), preoperative PSA level (continuously coded), pathological T-stage (pT2 vs pT3a vs ≥pT3b), pathological N-stage (N0 vs N1 vs Nx), pathological Gleason Score (3 + 3 vs 3 + 4 vs 4 + 3 vs ≥4 + 4), SM status (R0 vs R1), and extent of NS (bilateral vs unilateral vs no NS).

For comparison of the effect of the surgical approach on functional outcomes, we relied on PS-matching (3:1) for age at operation, prostate volume (both continuously coded), and NS (unilateral vs bilateral). The evaluation was further refined by categorising into age groups (youngest, middle and oldest tertile) and according to the degree of NS (unilateral vs bilateral). Patients exposed to neoadjuvant or adjuvant androgen-deprivation or adjuvant radiation therapies were excluded in these analyses, as those procedures impact oncological and functional outcomes [10].

Kaplan–Meier plots depict BCR-free survival in the matched cohort. Univariable and multivariable Cox regression models tested the relationship between BCR and surgical approach in the unmatched cohort. Adjustment was made for year of surgery, PSA level, pT- and pN-stage, pathological Gleason Score, and SM status. Logistic regression models tested the relationship between functional outcomes and surgical approach in matched cohorts.

Surgical outcomes over the study period were calculated as a monthly median value. For plotting, the Lowess smoother, a locally weighted polynomial regression function was used. To test for significant differences between the surgical approaches, ANOVA analysis was performed with an interaction term.

For all statistical analyses R software environment for statistical computing and graphics (version 3.4.1; R Foundation for Statistical Computing, Vienna, Austria) was used. All tests were two sided with a level of significance set at $P < 0.05$.

Results

Descriptive data of the overall patient population are presented in Table 1. In all, 64.9% of the patients received ORP vs 35.1% RARP. During the first years of the study period (2008–2010), more patients were treated with ORP (39.2% vs 10.0% RARP). Conversely, RARP was performed more frequently during the last years of the study period (2014–2016, 23.3% vs 58.0% RARP). ORP patients were older (64 vs 63 years in RARP), less frequently overweight (mean body mass index 26.5 vs 27.1 kg/m^2 in RARP), presented with lower pretreatment PSA level (9.1 vs 9.2 ng/mL in RARP), more frequently harboured pathological Gleason Score ≤3 + 4 (80.7% vs 78.7% in RARP; all $P < 0.01$), and less frequently pathological N0-disease (71.8% vs 80.0% in RARP). In those who underwent ORP, lymph node count (14.1 vs 14.2 nodes in RARP) and NS rates (95.6% vs 97.2% in RARP) were lower (all $P < 0.01$). There were no statistically significant differences for final pathological T-stage and SM status, the latter overall, as well as across pT-stages. The median follow-up was 48.5 vs 48.6 months for ORP vs RARP.

Oncological outcome

The PS-matching resulted in 4528 patients (3396 ORP vs 1132 RARP) (Table S4). In Kaplan–Meier analyses, 48-month BCR-free survival rates were 90.8% vs 89.3% in ORP vs RARP patients ($P = 0.12$; Fig. 1). In multivariable Cox regression models, relying on the unmatched cohort (9832 patients), surgical approach failed to reach independent predictor status for BCR (hazard ratio 0.90, 95% CI 0.77–1.04; $P = 0.16$; Table 2).

Functional outcomes

The PS-matching resulted in 5780 patients (4335 ORP vs 1445 RARP) for analysis of 1-week continence, 3964 patients (2973 ORP vs 991 RARP) for analysis of 3-month continence, 4632 patients (3474 ORP vs 1158 RARP) for analysis of 12-month continence, and 1232 patients (924 ORP vs 308 RARP) for analysis of 12-month potency (Table S5, S6).

For urinary continence, 1 week after catheter removal, slightly better continence rates were observed in ORP patients (Table S1). No pad was required in 25.8% vs 21.8% in RARP. One pad was used in 33.9% vs 30.9% in RARP ($P < 0.001$).

At 3 months after surgery, no statistically significant differences were observed between groups (77.0% vs 78.4% in ORP vs RARP). Conversely, at 12 months after surgery, modestly better continence rates were observed in RARP patients for the entire patient cohort (88.8% vs 90.3% in ORP vs RARP, $P = 0.01$; Fig. 2). When 12-month continence rates were evaluated across age groups (<61.7 vs 61.7–68.2 vs >68.2 years), no statistically significant differences were observed (90.4% vs 90.8%, 86.7% vs 89.7% and 80.4% vs 82.0% in ORP vs RARP, respectively).

For EF at 12 months after surgery, there were no statistically significant differences between the groups (Fig. 3; Table S2). Specifically, the proportion of patients across all age groups and NS status (uni- and bilateral) achieving an IIEF-5 score ≥18 was 48.5% vs 53.4% in ORP vs RARP ($P = 0.12$). In the youngest age group, potency rates were higher (60.4% vs 59.2% in ORP vs RARP), but also without a statistically significant difference between the approaches. Similar results were observed when the ability of achieving an erection sufficient for intercourse was compared. Success rates across all age groups and uni-/bilateral NS status were similar (83.0% vs 83.6% in ORP vs RARP, $P = 0.69$). Results were better in younger (89.9% vs 90.8% in ORP vs RARP) and worse in older (70.9% vs 81.0% in ORP vs RARP) men, but again did not differ significantly between the approaches.

Surgical outcomes

Overall, operation time was shorter for ORP (181 vs 200 min in RARP, $P < 0.001$; Fig. 4; Table S3). This difference was more pronounced during the first years of the study period. Intraoperative blood loss was higher in ORP (789 vs 279 mL in RARP, $P < 0.001$). This was reflected by a higher blood transfusion rate in ORP (3.5% vs 0.75% in RARP, $P < 0.001$). The overall time from surgery until catheter removal was significantly shorter for RARP patients (7 vs 12 days in ORP, $P < 0.001$). Although during the first years no relevant difference was observed, but from 2011 onwards the catheter was removed earlier in RARP patients. LOS was significantly shorter in the ORP group (7.6 vs 8.0 days, $P < 0.001$).

Discussion

Although RP represents one of the most commonly used treatment options in localised prostate cancer, it remains unclear which surgical approach (ORP vs RARP) might be superior. Numerous, mainly retrospective studies have shown inconclusive results [4,11,12].

The only randomised controlled trial comparing oncological and functional outcomes in ORP vs RARP was published by Yaxley et al. [3] and recently updated

Table 1 Descriptive characteristics of 10 790 RP patients, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).

Variable	Overall	ORP	RARP	*P*
Number of patients (%)	10 790	7007 (64.9)	3783 (35.1)	
Year of surgery, *n* (%)				
2008–2010	3125	2746 (39.2)	379 (10.0)	<0.001
2011–2013	3837	2628 (37.5)	1209 (32.0)	
2014–2016	3828	1633 (23.3)	2195 (58.0)	
Age at surgery, years				
Mean (median)	64 (64)	64 (65)	63 (64)	<0.001
IQR	59–69	59–69	58–68	
Surgical experience*, *n*				
Mean (median)		1076 (1007)	474 (352)	<0.001
IQR		616–1475	164–627	
BMI, kg/m^2				
Mean (median)	26.2 (26.6)	26.5 (26.1)	27.1 (26.5)	<0.001
IQR	24.4–28.4	24.3–28.3	24.5–29.0	
PSA level, ng/mL				
Mean (median)	9.1 (7.0)	9.1 (6.9)	9.2 (7.2)	0.004
IQR	5.1–10.1	5.0–10.1	5.2–10.2	
RP Gleason Score, *n* (%)				
3 + 3	1468	1032 (14.8)	436 (11.5)	<0.001
3 + 4	7148	4608 (65.9)	2540 (67.2)	
4 + 3	1722	1079 (15.4)	643 (17.0)	
≥8	433	275 (3.9)	158 (4.2)	
Missing	19	13	6	
pT-stage, *n* (%)				
pT2	7842	5076 (72.5)	2766 (73.2)	0.77
pT3a	2105	1375 (19.6)	730 (19.3)	
pT3b/pT4	832	547 (7.8)	285 (7.5)	
Missing	11	9	2	
pN-stage, *n* (%)				
pN0	2203	5020 (71.8)	3023 (80.0)	<0.001
pN1	8043	345 (4.9)	178 (4.7)	
pNx	523	1623 (23.2)	580 (15.3)	
Missing	21	19	2	
Number of lymph nodes removed				
Mean (median)	14.1 (12)	14.1 (12.0)	14.2 (12.0)	0.005
IQR	7–19	7–19	8–19	
SM status, *n* (%)				
Positive (R1)	1276	825 (11.8)	451 (11.9)	0.83
Negative (R0)	9505	6175 (88.2)	3330 (88.1)	
Missing	9	7	2	
SM status by pT-stage, *n* (%)				
pT2/R1	581	366 (7.2)	215 (7.8)	0.36
pT3a/R1	376	252 (18.3)	124 (17.0)	0.44
pT3b/pT4/R1	318	206 (37.3)	112 (39.3)	0.64
NS, *n* (%)				
Bilateral	8096	5202 (74.3)	2894 (76.5)	<0.001
Unilateral	2296	1513 (21.6)	783 (20.7)	
None	397	291 (4.2)	106 (2.8)	
Missing	1	1	–	

**Defined as the consecutive number of all surgeries of each surgeon. BMI, body mass index; IQR, interquartile range.*

by Coughlin et al. [13]. They showed lower complication rates, lower blood loss, less blood transfusions, shorter LOS, and shorter operation time in RARP patients. No significant differences were observed in early and long-term (24 months) functional outcomes. However, for oncological outcomes, there was a significantly lower BCR rate at 24 months in the RARP group (3% vs 9%; $P = 0.02$). Nevertheless, these results need to be interpreted with caution, as the postoperative management was not standardised between groups and a higher (although not statistically significant) proportion of patients were treated with adjuvant radiation therapy in the RARP group (10% vs 7%). Additionally, the ORP surgeon was more experienced (>1500 ORPs) than the RARP surgeon (200 RARPs) before recruiting into the study.

The non-randomised, prospective LAParoscopic Prostatectomy Robot Open (LAPPRO) study evaluated functional outcomes of the surgical approaches by

Fig. 1 Kaplan–Meier plot comparing the BCR-free survival rates between 4528 RP patients, stratified according to surgical approach (ORP vs RARP) after 3:1 PS matching.

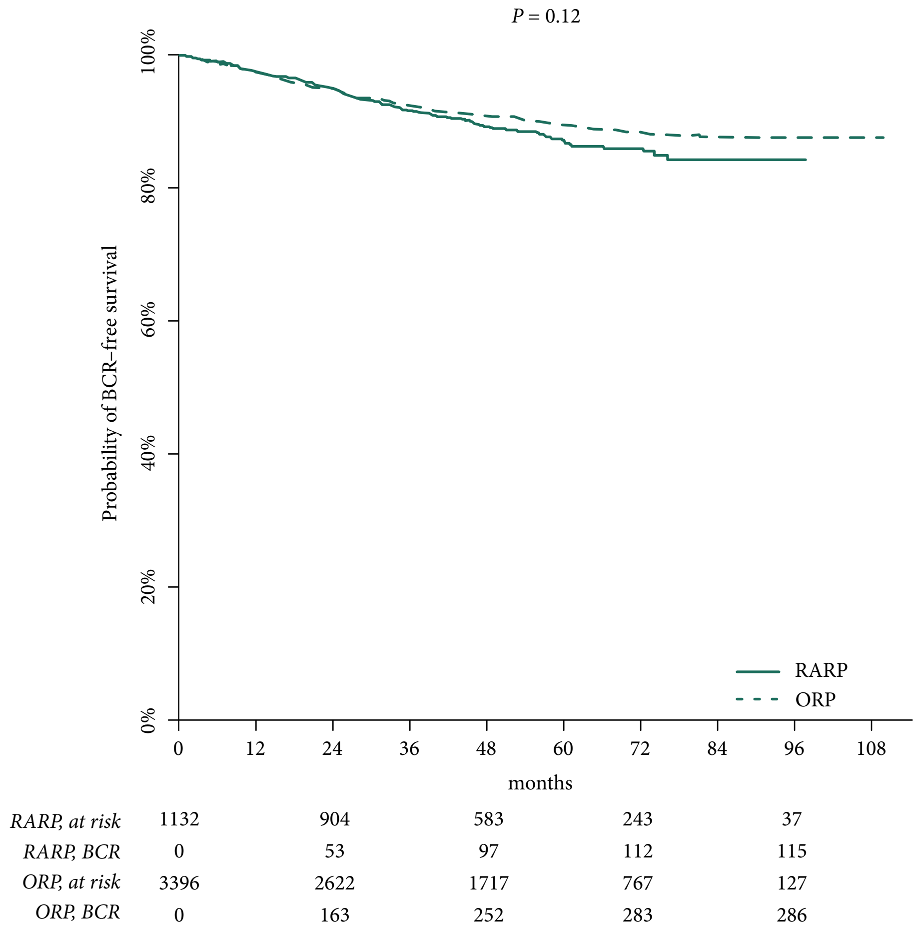


Table 2 Multivariable Cox regression models testing the effect of different variables on the probability of BCR after RP.

Variable	Hazard ratio	95% CI	*P*
Surgical technique			
RARP vs ORP	0.90	0.77–1.04	0.12
Year of surgery	0.94	0.91–0.97	<0.001
PSA level	1.0	1.001–1.005	<0.001
pT-stage			
pT3a vs pT2	2.15	1.87–2.48	<0.001
pT3b/pT4 vs pT2	2.59	2.14–2.48	<0.001
pN-stage			
pN1 vs pN0	1.75	1.43–2.14	<0.001
pNx vs pN0	0.78	0.65–0.95	0.01
Gleason Score			
3 + 4 vs 3 + 3	2.18	1.58–3.02	<0.001
4 + 3 vs 3 + 3	5.02	3.56–7.07	<0.001
≥8 vs 3 + 3	5.24	3.56–7.70	<0.001
SM			
Positive vs negative	1.96	1.70–2.25	<0.001

comparing 778 ORP vs 1847 RARP patients in 14 Swedish centres [5]. After the 12-month follow-up, there were no statistically significant differences between groups for urinary continence rates. For EF, a small but statistically significant difference was seen in favour of RARP, which was confirmed at the 24-month follow-up (rate of erectile dysfunction: 68% vs 74% in ORP) [14,15].

However, virtually all studies comparing oncological and functional outcomes between ORP vs RARP rely on surgeons performing either one of the surgical approaches, but not both during the same study period. Consequently, the question of superiority remains unanswered, as surgeons and not the surgical approach itself was compared previously. Based on these notions, we addressed this issue in the present study, relying on the unique information of >10 000 men treated by highly trained surgeons for both surgical approaches.

Our analyses demonstrated several noteworthy findings. First and foremost, no statistically significant differences in BCR-rates at 48-months of follow-up were observed. Moreover, surgical approach failed to reach independent predictor status in the multivariable models. This is in contrast to the findings of Coughlin et al. [13], who

Fig. 2 Comparison between RP patients, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP) with respect to the continence status at 1 week after catheter removal (**A**), 3 months after surgery (**B**), and 12 months after surgery (**C**). Moreover, continence rates at 12 months after surgery were compared between groups according to patient age at time of surgery (**D**).

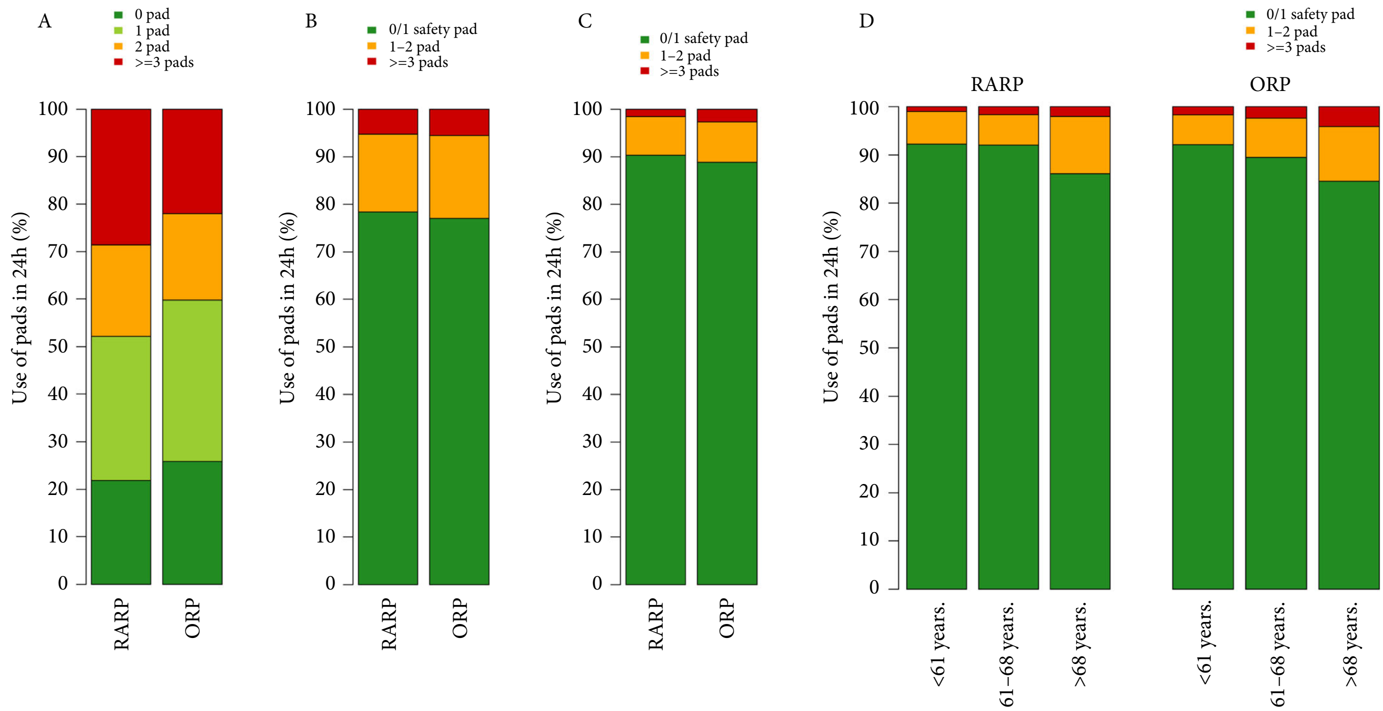
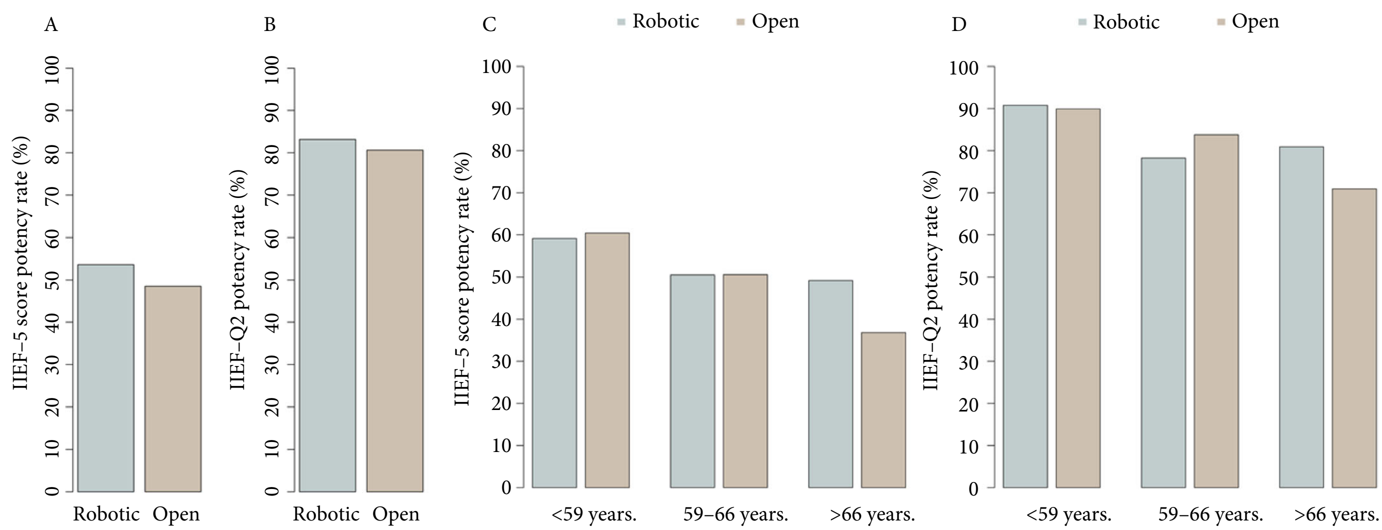
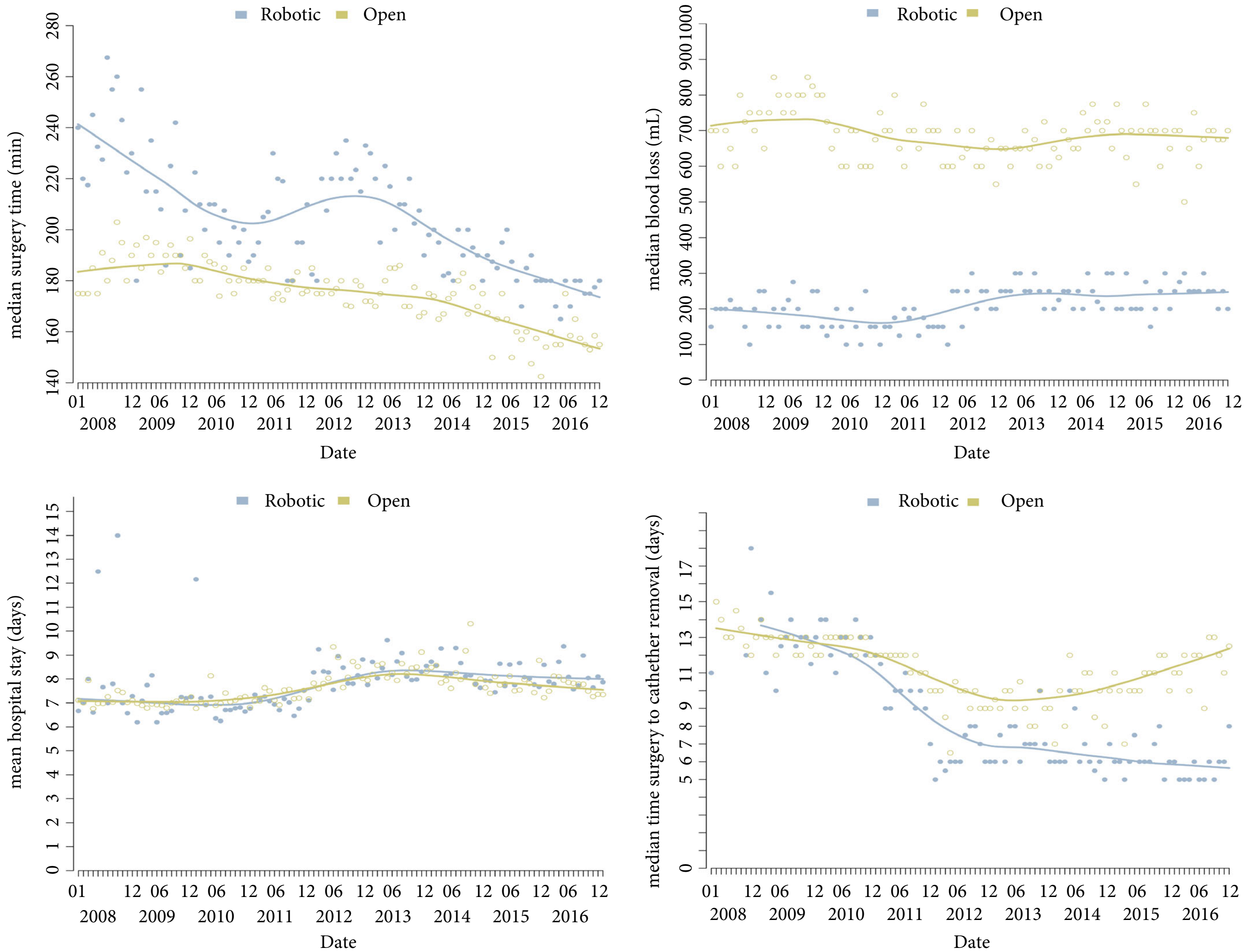


Fig. 3 Comparison of EF rates at 12 months after surgery between 1232 RP patients (3:1 PS-matched cohort) treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP). **A**, shows the proportion of all patients achieving an IIEF-5 score of ≥18. **B**, shows the proportion of all patients achieving a score of ≥2 in questions number two of the IIEF-5. **C** and **D** show the respective results according to age groups.



described a higher risk of BCR after ORP. However, with a follow-up length twice as long in our present cohort, and standardised post-surgical treatment recommendations regardless of surgical approach, our study allows more generalisable conclusions. This is validated by comparable rates of positive SMs and lymph node yield in both surgical approaches in our present cohort.

Fig. 4 Comparison between 10 790 RP patients, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP) with respect to operation time, intraoperative blood loss, LOS, and days until catheter removal over time.



Second, for functional outcome, we found slightly better continence rates at 1 week after catheter removal in the ORP group. This difference levelled out at 3 months. Conversely, at 12 months after surgery, a slightly higher proportion of patients regained continence in the RARP group (overall difference of 1.5%). However, it is arguable if this observed difference is clinically relevant, especially as the differences were not statistically significant when continence rates were compared according to age groups. This supports the findings of the LAPPRO study, which did not observe statistically significant differences for urinary continence between ORP vs RARP [15].

Additionally, regarding EF at 12 months after surgery, no statistically significant differences in ORP vs RARP were observed. The analyses included an overall comparison of the proportion of preoperatively potent patients after bilateral NS who achieved an IIEF-5 score ≥18 and a comparison of the proportion of patients whose erections were hard enough for penetration, both subdivided by age groups. Although no significant differences were observed, a trend towards a slight advantage for RARP patients is visible, consistent with recent reports [6,15,16].

Third, we compared surgical outcomes. As expected, median intraoperative blood loss and transfusion rates were significantly lower in the RARP cohort. Conversely, the operation time was significantly shorter in favour of ORP patients. Further endpoints such as positive SM rates, lymph node yield or LOS did not reveal clinically meaningful differences between the groups. The median time from surgery to catheter removal was significantly shorter in the RARP patients, with a more pronounced difference during the second half of our present study. These findings are consistent with our previously published data, as well as with other reports [17,18]. As RARP patients were more obese within our present cohort, an advantage of RARP may be assumed in obese patients, as previously shown [19]. Additionally, RARP allows even men with severe and morbid obesity to undergo the surgery [20,21]. It is of note, that LOS reflects reimbursement policy in Germany. Consequently, this renders comparison with other international data impossible. In general, shorter LOS has been shown for RARP [3,22].

Taken together, the question remains why RARP is disseminating so rapidly despite the lack of superiority for the most important quality markers along with its higher costs compared to ORP [23,24]. We strongly believe that the introduction of the robotic approach has fuelled the building of high-volume centres in which the proven advantages of high caseload are further delivered [25]. Centralisation and constitution of high-volume centres in combination with transparent development of quality criteria and a curriculum for surgical training are key for high-quality outcomes of RP as for any medical procedure. It has been shown that the introduction of a quality assurance programme (QAP) improves prostate cancer care in terms of consistency of patient selection and outcomes of surgery during a period of major re-organisation of cancer services [26]. High-volume centres allow the implementation of QAPs, which are as important to improve outcome of surgical procedures as the experience of surgeons and institutes [27]. The introduction of RARP has become a key driver for centralisation and the acquisition of a robotic system leads to an increased caseload of RP along with a decreasing caseload in hospitals not offering robotic surgery [2]. Finally, in addition to surgical volume and QAP, surgical training plays a vital role and robotic technology offers options beyond the possibilities of open surgery. Next to the well-established training programmes in robotic surgery, a structured internationally recognised curriculum is established for RARP where surgeons with limited robotic experience can increase their robotic skills and ability to perform the surgical steps of RARP [28]. However, such programmes do not exist for ORP. Furthermore, technologies such as advanced visualisation, telementoring, simulation of procedures, and the possibility of recording operations, allow quality assessment of single procedures as well as completely new ways of quality evaluation such as peer and crowd-sourced assessment of technical surgical skills [29]. In conclusion, the improvement in the quality of RP largely revolves around centralisation, the implementation of high-volume centres and QAPs, as well as on the initiation of structured surgical training programmes; all of which have been catalysed and accelerated by the introduction of RARP [2].

Our present study has several strengths that distinguish it from previous reports. To the best of our knowledge, it includes the largest number of patients comparing ORP vs RARP. Moreover, all patient-reported outcomes are prospectively collected. The single-centre nature of our present study might at first glance limit generalisability; however, we consider it a strength, as the pre-surgical preparation, the intra- and postoperative pathological evaluation of the specimens, and postoperative management including the standardised data collection was identical in all patients irrespective of the surgical approach. This renders further comparability between ORP vs RARP and is unique in the existing literature, allowing the best possible assessment of the impact of the surgical approach itself.

Several limitations of our present study need to be mentioned. Although PS-matching was performed to minimise the risk of biases adherent to non-randomised studies, potential unknown selection biases remain, even after the most stringent adjustment. Moreover, the difference in number of cases is evident, as well as the previous ORP experience of all surgeons before starting training for RARP. However, to minimise the effect of the potential learning-curve, the first 100 RARP procedures of each surgeon were excluded. Furthermore, due to the high previous ORP experience, our present results may not be fully generalisable, as in today's clinical setting robotic surgery is the predominant approach. Hence, this might render our present results less applicable to other centres with less ORP experience. In addition, due to the existing high surgical experience before starting RARP, results may be shifted similarly towards better results with increasing experience in both procedures. In an ideal scenario, a novice surgeon would start his RP series with alternating, randomly assigned cases of either ORP or RARP. As this is rather unrealistic to accomplish, the presented data must be considered as the best current information to compare the two surgical approaches.

Taken together, the surgeon's experience seems to be the most important factor for good outcomes following RP regardless of the surgical approach. Our data substantialise this hypothesis in the largest series published to date. Specifically, similar oncological and functional outcomes after RP were observed. In addition, we corroborate the previously observed findings of lower transfusion rates and shorter time to catheter removal after RARP.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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Abbreviations: BCR, biochemical recurrence; EF, erectile function; IIEF-5, five-item version of the International index of erectile function; IQR, interquartile range; LAPPRO, LAParoscopic Prostatectomy Robot Open (study); LOS, length of hospital stay; NS, nerve sparing; PS, propensity score; pT-stage, pathological T-stage; QAP, quality assurance programme; (O)(RA)RP, (open) (robotic-assisted) radical prostatectomy; SM, surgical margin.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Comparison of continence rates between RP patients, treated between 2008 and 2016 in a single

high-volume centre, stratified according to surgical approach (ORP vs RARP).
Table S2. Comparison of EF rates at 12 months after surgery between 1232 RP patients (3:1 PS-matched cohort) treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).
Table S3. Intra- and postoperative outcomes of 10 790 RP patients, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).
Table S4. Descriptive characteristics of 4540 RP patients after 3:1 PS matching used for Kaplan–Meier analyses predicting BCR-free rates, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).
Table S5. Descriptive characteristics of RP patients after 3:1 PS matching used for logistic regression models predicting urinary continence after 1 week (a), 3 months (b) and 12 months (c), treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).
Table S6. Descriptive characteristics of 1232 RP patients after 3:1 PS matching used for logistic regression models predicting EF after 12 months, treated between 2008 and 2016 in a single high-volume centre, stratified according to surgical approach (ORP vs RARP).