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# A short-term cost-effectiveness study comparing robot-assisted laparoscopic and open retropubic radical prostatectomy

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Abstract

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An economic evaluation was made to estimate direct costs of the first postoperative year and an incremental cost-effectiveness ratio (ICER) per successful surgical treatment and per quality-adjusted life-year (QALY). A successful RP was defined as: no residual cancer (PSA <0.2 ng/ml, preserved urinary continence and erectile function. A one-way sensitivity analysis was made to investigate the impact of changing one variable at a time.

**Results:**

The ICER per extra successful treatment was €64,343 using RALP. For indirect costs, the ICER per extra successful treatment was €13,514 using RALP. The difference in effectiveness between RALP and RRP procedures was 7% in favour of RALP. In the present study no QALY was gained 1 year after RALP, however this result is uncertain due to a high degree of missing data. The sensitivity analysis did not change the results noticeably.

**Limitations:**

The study was limited by the design resulting in a low percentage of information on the effect of medication for erectile dysfunction and only short-term quality of life was measured at 1 year postoperatively.

**Conclusion:**

RALP was found to be cost-effective compared to RRP. The effectiveness may be to preserve the potential of each robotic procedure.

**Keywords:** Prostatectomy, Robotics, Prostatectomy, Robotics



**Introduction:**

Prostatectomy is a common procedure in urology. Due to the increasing incidence of prostate cancer, the need for effective treatment is growing. The aim of this study was to evaluate the cost-effectiveness of RALP compared to RRP.

The increased use of RALP from 1% in 2001 to 40% in 2006 has opened up a debate concerning prioritisation of the economic resources between RALP and RRP which is related to the purchase and maintenance of the operative equipment for RALP<sup>1-3</sup>. As in other countries, the use of RALP in Denmark has expanded rapidly. The incidence of prostate cancer was 136 per 100,000 men and the disease specific mortality 19.5 per 100,000 patients in Denmark in 2008<sup>4,5</sup>. At Aarhus University Hospital, Skejby, RRP has been performed as a standard procedure since 1997 and is still a common methodology; RALP was introduced in 2005 using the da Vinci system.



A health economic evaluation was performed alongside a retrospective cohort-control study of prostate cancer patients treated with radical prostatectomy and followed 1 year postoperatively. The incremental cost-effectiveness ratio (ICER), i.e. the extra costs of RALP compared to RRP divided by the extra gained patient outcome from RALP compared to RRP, was calculated according to international guidelines on health economic evaluation<sup>[11](#)</sup>. The ICER was calculated from a societal perspective, i.e. all costs were included. All prices were quoted in euros, 2008 prices, and exclusive of value added tax (VAT).

Two outcome measures were used: (1) a successful surgical treatment and (2) quality-adjusted life-years (QALY). Successful radical prostatectomy was defined as no residual cancer (prostate-specific antigen (PSA) <0.2 ng/ml), urinary continence and erectile function with or without medical treatment. To estimate QALY within the first postoperative year, the SF-36 score was translated to SF-6D using Brazier's algorithm<sup>[12](#)</sup>. The patients were asked to fill out a SF-36 questionnaire at baseline and 1 year postoperatively. SF-36 is a generic, but not a preference-based instrument and, thus, needs to be 'translated' into utility-weights to be used to calculate gained QALYs. The difference in the derived utility-weight between baseline and 1 year constitutes the gained QALYs for each group.

A cost-effectiveness analysis was made to estimate ICER per successful operation with and without RALP. The cost-utility analysis was performed according to the method<sup>[11](#)</sup>. A

The effect of RALP compared to RRP was evaluated in a one-way sensitivity analysis.

Clinical

The study was conducted at the Department of Urology, Rigshospitalet, University Hospital, Copenhagen, Denmark. The study was approved by the local ethics committee at Skejby Hospital.

The RALP and RRP groups were compared in terms of postoperative complications, time to discharge, and the need for further treatment. The primary outcome was the conclusion of 77 patients who had undergone RRP, and 77 patients who had undergone RALP).



incontinence and recurrence postoperatively and were mainly assigned to the open procedure.

The power was calculated to be 23% based on the study population of 231 men and the minimum relevant difference for a successful surgical treatment of 7% between the two groups of patients.

All patients were followed prospectively according to department procedures for the Prostate Cancer project. Each patient was observed from day of surgery to 1 year postoperatively where differences in side-effects were assumed to be steady state. Long-term follow-up of the oncological outcome was desirable but was outside the scope of this study.

The in-hospital data were collected from the medical journals. Data on general practitioner consultations, acute hospital admissions were collected from the Danish National Registry of Patients at the Danish National Board of Health and from the Health Service Registry, Central Denmark Region. Data on absence from work was taken from The Sickness Absence Registry at the Ministry of Employment.

All patients had three outpatient visits during the first postoperative year as planned follow-up visits at 3, 6, and 12 months postoperatively. The short form health survey SF-36 was filled in at baseline and 1 year postoperatively.

### Costs

The value of the robot was estimated in Table 1.

Table 1. Every

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The life expectancy was estimated by 3% to da Vinci robot was calculated to

be €380,135 using the standard annualisation method<sup>11</sup>. Maintenance costs were estimated to be €120,100 per year<sup>25</sup>.

It was assumed that 70 RALP procedures were performed annually based on the level of activity in 2008 at our department. The costs for da Vinci were distributed between a total of 110 robot-assisted procedures yearly (70 RALP plus 40 different procedures performed with the same equipment).

The cost of managing side-effects during the first postoperative year by consultations in hospital and primary care as well as the cost of urinary pads and medical drugs were all included in the total cost calculations for both RALP and RRP.

The use of staff resources (nurses and supporting personnel) was estimated by interview. Data concerning sick leave after RP was observed for 1½ years based on previous experiences<sup>26</sup>.

The study was approved by the local ethical committee and the Danish Data Protection agency was informed.

# Statistics

The two groups of patients were compared using descriptive statistics, tested with t-test,  $\chi^2$ -test or the non-parametric Wilcoxon rank-sum (Mann-Whitney) test as appropriate.

## Result



2. The difference was 7% in favour of the function medication

## Display Table

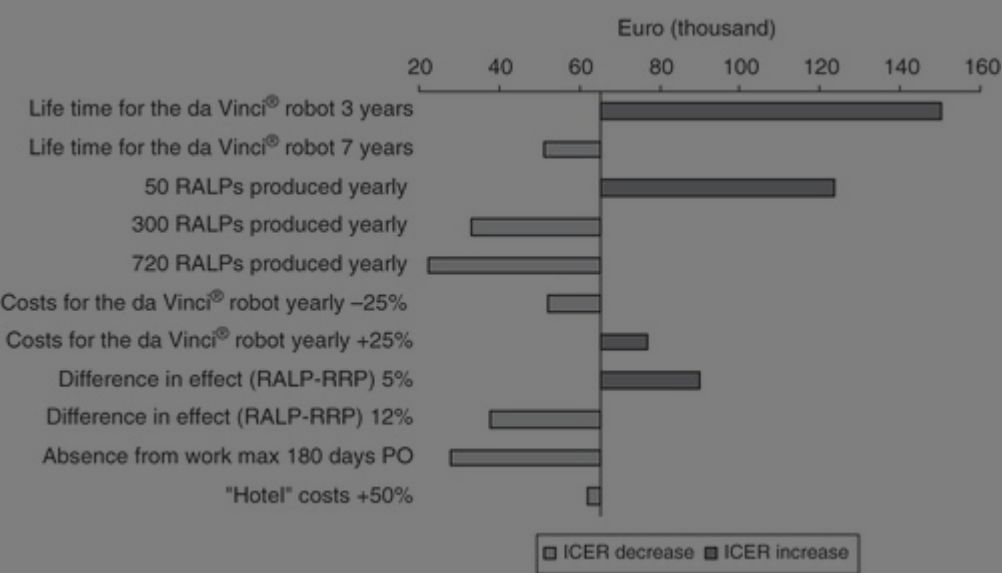
The mean costs per patient and the estimated ICER are presented in [Table 3](#). The mean costs per RALP procedure were twice the costs of RRP 1 year postoperatively. Concerning the mean indirect costs per patient, there was no statistically significance between the two groups of patients ([Table 3](#)).



Figure 1. *on the*



radical prostatectomy. The ICER was estimated assuming 70 RALP were performed annually with the costs for the da Vinci distributed between 110 robot-assisted procedures yearly and a life time for the da Vinci robot of 5 years. A successful treatment was defined as no residual cancer (prostate-specific antigen <0.2 ng/ml), preserved urinary continence and erectile function 1 year postoperatively. RALP robot-assisted laparoscopic radical prostatectomy; RRP, retropubic radical prostatectomy; PSA prostate-specific antigen; PO, postoperatively; ICER, incremental cost-effectiveness ratio.



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comparing RALP and RRP procedures have estimated costs from a broad societal perspective with a similar high level of precision in costing. The results of previous economic studies are opaque because they are based on different cost models as well as non-clarified methods<sup>2,3,6,7</sup>. Minutely, the present study followed the internationally recommended methods for economic evaluation<sup>11</sup>.

The study estimated incremental effectiveness and costs comparing RALP and RRP procedures. Estimating the success of the treatments we wanted an outcome measure that made a difference and included the potential benefits for RALP stated by the manufacture of the robotic system<sup>27</sup>. It is documented that there are no significant differences in continence, erectile function and biochemical progression-free survival between RALP and RRP<sup>1,8,9</sup>. Therefore, we consider the chosen outcome measure “successful treatment” useful in the discussion of priority of the economic resources between RALP and RRP procedures. The retrospective study design resulted in a low percentage of information on the effect of medication for erectile dysfunction at 1 year postoperatively. A greater share of RALP patients had used prescriptions for medicine for erectile dysfunction compared to RRP patients indicating that more RALP patients might have an erectile function than estimated in our study. Furthermore, two thirds of the RALP patients underwent nerve-sparing surgery compared to half of the patients operated RRP.

Our study had some limitations. First, the retrospective design may have led to selection bias. Second, the effectiveness of the treatments was assessed by the SF-36, only at baseline, where the patient was reminded to complete the questionnaire as an outpatient. Third, the control group may have been satisfied RALP patients that were not operated to RRP<sup>10</sup>. Even though the control group is not eliminated, the retrospective design may have led to selection bias. The control group was based on the clinical T...



in RRP patients indicating a higher risk at final pathology for patients undergoing RRP and that patients with lower tumour stage were predominantly selected to RALP. Secondly, QALY indicates a side-effect, and quality of life might be more crucial to patients operated by RALP compared with a quicker recovery of continence and erectile function. A randomised controlled trial with long-term follow-up of effectiveness and quality of life between RALP and RRP is therefore warranted along with standardised reporting of outcomes<sup>28</sup>. At least better data on quality of life after RALP and RRP should be obtained.

We calculated the ICER per successful treatment with and without indirect costs. It is uncertain whether the decision makers find it relevant to include indirect costs. Furthermore, estimating absence from work is methodologically uncertain.

Two previous cost studies included the fixed costs for da Vinci basing the calculations on 300 RALP procedures yearly and a lifetime for the da Vinci robot of 7 years<sup>3,7</sup>. Additionally, the annual purchase and the maintenance costs for the da Vinci robot in the two studies were estimated to be lower; €807,800 and €72,629, respectively<sup>3,7</sup>. In our study the purchase was estimated to €1.4 million while the maintenance was €120,100 per year. Consequently, the costs for RALP are higher in our study.

Only one of the previous cost studies had made a sensitivity analysis showing that the costs for RALP are volume dependent where an increased volume of RALP demonstrates a lower cost. Our sensitivity analysis shows that the costs for RALP are increasing with the number of procedures. This is due to the fact that the effectiveness of RALP is lower than RRP. With three procedures the effectiveness of RALP is lower than RRP. Furthermore, the cost of the da Vinci robot may be higher than the cost of the RRP procedures, and the effectiveness of RALP is lower than RRP.

Conclu



It is uncertain whether the RALP procedure is cost effective. The incremental costs per extra successful procedure were €64,343. A long-term follow-up of the outcome measures and sick leave may intensify the assessment of the cost effectiveness between the two alternatives.

## Transparency

### Declaration of funding

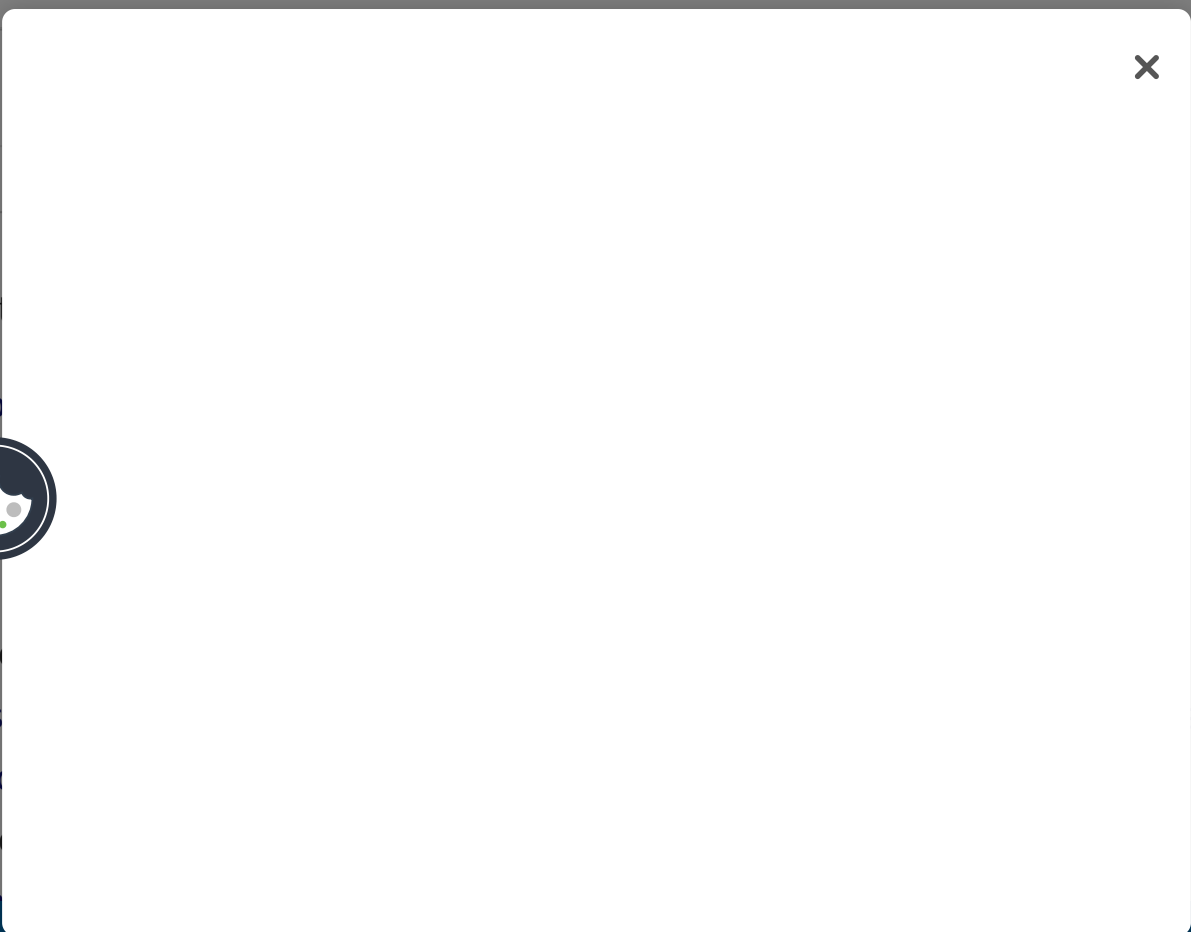
No declaration of funding is to be declared.

### Declaration of financial/other relationships

No financial or other financial relationship is to be declared.

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Robotic Assisted Laparoscopic Prostatectomy Versus Radical Retropubic

Prostatectomy for Clinically Localized Prostate Cancer: Comparison of Short-Term Biochemical Recurrence-Free Survival

Source: The Journal of Urology

Downsides of Robot-assisted Laparoscopic Radical Prostatectomy: Limitations and Complications

Source: European Urology

Retropubic, Laparoscopic, and Robot-Assisted Radical Prostatectomy: A Systematic Review and Cumulative Analysis of Comparative Studies

Source: European Urology

Biochemical Outcome After Radical Prostatectomy, External Beam Radiation Therapy, or Interstitial Radiation Therapy for Clinically Localized Prostate Cancer

Source: The Journal of Urology

Comparative Effectiveness of Minimally Invasive vs Open Radical Prostatectomy

Source: JAMA

Cost Comparison of Robotic, Laparoscopic, and Open Radical Prostatectomy for Prostate Cancer

Source: European Urology

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