JOURNAL OF ENDOUROLOGY
Volume 00, Number 00, XXXX 2010

Pp. ■■■–■■■
DOI: 10.1089/end.2010.0382

Changes in Penile Length After Robot-Assisted Laparoscopic Radical Prostatectomy

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Abstract

Background and Purpose: Radical prostatectomy is commonly performed for the treatment of patients with prostate cancer. Several studies have demonstrated a reduction in penile size after open radical retropubic prostatectomy. The objective of this study is to describe changes in penile length after after robot-assisted laparoscopic radical prostatectomy (RALRP).

Patients and Methods: We performed a randomized, open label, multicenter study in men with normal erectile function who underwent bilateral nerve-sparing radical prostatectomy. We evaluated changes in measured stretched penile length (SPL), a secondary end point of the study, in a subset of men from a single site who underwent RALRP by one surgeon. They were randomized to either intraurethral alprostadil 125 to 250 μg daily or oral sildenafil citrate 50 mg daily for 9 months. SPL was measured from pubic bone to coronal sulcus using a semirigid ruler before surgery and at 1, 3, 6, 9, 10, and 11 months.

Results: A total of 127 patients were enrolled and 94 completed the 11-month follow-up. The mean patient age was 56.5 years. Baseline mean SPL (cm) before surgery was 11.77 and decreased to 11.13 at 1 month ($P < 0.0001$). A trend toward recovery of SPL was seen at 3 and 6 months. Mean SPL was not significantly different from baseline at 9, 10, and 11 months.

Conclusions: This report describes changes in SPL over time after RALRP for prostate cancer. The expected decrease in length was observed shortly after surgery, but, by 9 months, penile length had returned to the preoperative measurement.

Introduction

Radical prostatectomy (RP) for prostate cancer can lead to urinary incontinence and erectile dysfunction (ED). In addition, several studies have shown that penile length is often decreased after RP. More than half of patients may experience decreased penile length after RP, frequently averaging as much as 1 cm.[1–3] This negative outcome has been associated with decreased erectile function[4] (EF) and may affect self-esteem and overall quality of life after surgery. The mechanisms of changes in length are not well understood, but may be related to nerve sparing, corporal fibrosis, and recovery of EF.[4–7]

Several effective treatments have been described for improving penile length and recovery of EF after RP. Raina and associates[8] reported less shortening with the use of a vacuum erection device (VED). Intraurethral alprostadil (IUA) and sildenafil citrate (SC) have both been shown to be effective agents for recovery of EF after RP.[9–12]

Since initial early reports, robot-assisted laparoscopic radical prostatectomy (RALRP) has become a common procedure for prostate cancer treatment.[13–15] There is some controversy regarding the superiority of robotic *vs* open surgery with respect to blood loss, length of hospital stay, convalescence, cost, and complications.[15] In several comparisons among experienced surgeons, short-term clinical and pathologic outcomes appear to be comparable.[16,17]

Previous studies describing changes in penile length have not used medical therapy for penile rehabilitation (PR) or included men who underwent prostatectomy via the robotic approach. The objective of this study was to describe changes in penile length in men who were receiving standardized PR after RALRP for prostate cancer.

Patients and Methods

The results from this study represent a population of men from a single clinical site who were part of a larger, open label,

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Table 1. Mean Preoperative, Postoperative, and Change in Stretched Penile Length (cm), By Visit (Months)

Months after surgery	*Number of subjects*	*Mean preoperative SPL (cm)*[a]	*Mean SPL at follow-up (cm)*	*Mean SPL change (cm)*	P *value*
1	127	11.77	11.13	0.64	0.0001
3	119	11.80	11.48	0.32	0.009
6	111	11.78	11.52	0.26	0.02
9	105	11.81	11.73	0.08	0.54
10	99	11.78	11.60	0.18	0.22
11	94	11.76	11.70	0.06	0.68

[a]The mean preoperative stretched penile length (SPL) at each visit was calculated from patients who were available at each postoperative visit.

three-center study to evaluate the effects of PR on erectile function after bilateral nerve-sparing RP. Institutional Review Board approval was obtained at all sites. At two of the sites, the surgery was conducted using an open procedure (RRP). At a third site, which is the focus of this report, patients underwent RALRP via the transperitoneal approach with bilateral nerve sparing using interfascial technique. Inclusion criteria included age less than 70, International Index of EF (IIEF) score of 26 or greater, sexual activity with a consenting partner, and no history of penile deformity, Peyronie disease, or penile or urethral surgery. The EF Domain of the IIEF was the primary clinical end point, while SPL was a secondary end point. The detailed inclusion/exclusion criteria, study protocol, adverse effects, dropout rates, and EF data are described in a separate publication, which recently reported the combined results of the trial.[12]

Patients had a physical examination and completed the IIEF questionnaire approximately 1 month before surgery. Patients were randomized in a 2:1 manner to receive nightly IUA 125 μg, or oral SC 50 mg, within 1 month after surgery. Patients receiving IUA were titrated up to 250 μg nightly as tolerated by 2 months after surgery. Stretched penile length (SPL) was measured presurgery and at 1, 3, 6, 9, 10, and 11 months after surgery. Other parameters that were evaluated during the study included a global assessment ("Has the treatment you have been taking during this study improved your erection?"), IIEF, adverse events and the ED Inventory of Treatment Satisfaction (EDITS) (final visit only).

SPL was measured from the pubic bone to the coronal sulcus with a semirigid ruler. All measurements were made by one of two examiners who were blinded to previous measurements. Interoperator agreement was assessed by performing a blinded set of measurements on the initial 10 patients who were measured by the second examiner.

Postoperative SPL was compared with preoperative SPL using a paired Student t test (two-tailed). Because of patients withdrawn from the study, we calculated the mean as each patient's preoperative SPL change from follow-up postoperative measurements. A Rao-Scott Pearson chi-square test was also used to compare the overall SPL change with IIEF scores across all times points. All tests were considered statistically significant at $\alpha = 0.05$. All analyses were performed with SAS version 9.1.3 (SAS Institute, Cary, NC).

Results

A total of 212 patients started this study at three sites and 156 completed the trial. At the robotic site (the focus of this report), 127 men started the study and 94 completed the 11-month follow-up. Mean age of the robotic cohort was 56.5 years. Mean and median follow-up for the cohort was 9.5 and 11 months, respectively.

The mean preoperative SPL was 11.77 cm. The distribution of penile lengths was normal at baseline. Mean change in SPL is shown in Table 1. One month after surgery, mean SPL was 11.13 cm, a reduction of 0.64 cm from baseline ($P = 0.0001$). At the 3- and 6-month visits, SPL remained significantly decreased compared with the baseline visit. At the 9-, 10-, and 11-month visits, mean SPL was not statistically different from preoperative measurements. Throughout the study, there was a trend toward recovery of penile length that was significant by the visit 9 months after surgery (Fig. 1). There was no significant difference in mean SPL between PR treatment groups at baseline or follow-up visits. Likewise, these findings remained significant at visits 9, 10, and 11 when SPL was examined by group enrolled (in groups of 20). This suggests that measurement technique was consistent throughout the study.

Change in SPL was significantly associated with return of sexual function, as measured by the IIEF, overall in our series ($P < 0.001$) and specifically at month 11 ($P = 0.023$) but not at earlier time points in the study. No such correlation was found between change in SPL and age, baseline SPL, hypertension, preoperative medications or comorbidities, prostate weight, surgical complications, or other pathologic parameters. SPL change was grouped into quartiles and by amount of shrinkage at all follow-up time points (Table 2).

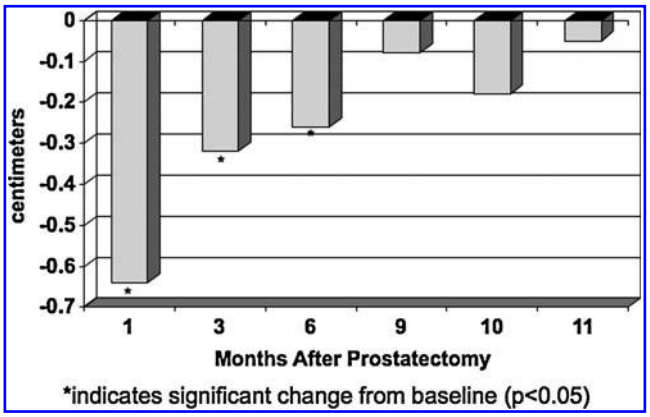

FIG. 1. Mean change in penile length.

Table 2. Stretched Penile Length Change Across All Follow-Up Time Points

Postoperative visit (mo)	*Number of patients*	*First quartile (cm)*	*Median value (cm)*	*Third quartile (cm)*	*Maximum value (cm)*	*Number of patients ≤0.5 (cm)*	*Number of patients 0.5–1.5 (cm)*	*Number of patients 1.5–2.5 (cm)*	*Number of patients 2.5–3.5 (cm)*
1	127	0	0.5	1.3	3.5	77	28	14	8
3	119	−0.3	0.5	1	3	80	20	15	4
6	111	−0.5	0	1	3.5	76	24	9	2
9	105	−0.5	0	1	4	73	22	9	1
10	99	−0.5	0	1	4.5	68	16	11	4
11	94	−0.5	0	0.9	3	70	17	5	2

The main adverse events were those commonly associated with the two treatments that were evaluated in this study, and included flushing and headache after SC and penile burning with IUA.

Discussion

This report is the first to describe changes in SPL occurring in patients who underwent RALRP. Data were collected in a prospective manner, and all patients met strict entry criteria with normal preoperative EF and received standardized PR. To our knowledge, this single surgeon robotic cohort also represents the largest sample size of any published report that describes changes in penile length after RP.

In the combined group of patients in this multicenter trial, SPL generally decreased in each treatment arm (IUA and SC), and began and ended at virtually identical end points.[12] While there appeared to be an overall decrease in SPL that was sustained in the multicenter group, the subset of patients who underwent RALRP appeared to experience a recovery of penile length that had returned to baseline measurements by 9 months.

Decreased penile length has been described previously after open RRP.[1–3] Munding and colleagues[1] evaluated changes in stretched penile length (SPL) after RRP in 31 patients. The authors reported that SPL was decreased 0.5 to 4.0 cm in 22 (71%) of the participants 3 months after surgery, with 15 of these having a decrease of at least 1 cm. Savoie and coworkers[2] reported on a series of 63 men who had RRP for prostate cancer. Repeated penile size measurements were conducted every 3 months after surgery. Sixty-eight percent of the patients reported some degree of penile shortening after surgery. There was a highly significant reduction in flaccid and SPL, and 12 patients had a decrease of at least 15% in SPL. Fraiman and associates[3] assessed penile length changes in 100 men who had a nerve-sparing RRP. There was a decrease in all penile dimensions that were measured subsequent to surgery, with the reduction in length being 9%. The largest decrease occurred between 4 and 8 months after the operation.

Preservation of penile length may predict recovery of EF. In a study of 126 patients who were undergoing nerve-sparing RRP, Gontero and colleagues[4] reported that a maximum decrease in SPL of 0.84 cm was recorded at catheter removal. After 1 year, penile length was still significantly reduced, although the change was less than seen at catheter removal. They found that recovery of EF was independently associated with loss of penile length. Briganti and coworkers[18] measured penile length and EF in 33 patients who underwent bilateral nerve-sparing RRP by a single surgeon.[18] Patients were evaluated for EF and penile length and circumference before surgery and at 6 months after surgery. The authors reported no difference between the preoperative and postoperative mean IIEF scores, and there was no effect of surgery on flaccid or erect penile length or circumference. While they found no difference between preoperative and postoperative results, they also suggested that there may be a correlation between penile size and EF.

Few studies have examined the effects of intervention or PR on penile length after RP. Köhler and colleagues[19] evaluated the effect of a VED on EF and penile length after surgery. In this study, men were instructed to use a VED starting either 1 month or 6 months after surgery. Those patients who started using the VED at 1 month reported mild-to-moderate ED at 3 and 6 months; penile length was minimally decreased at 3 months (0.24 cm) and was actually increased by 0.6 cm at 6 months. In contrast, those men who did not initiate VED use until 6 months after surgery classified themselves as having worse than mild-to-moderate ED; these men lost 1.87 cm and 1.82 cm of penile length at 3 and 6 months, respectively. These results suggest that maintenance of penile size may translate into less severe ED and that PR may play a role in this effect. Dalkin and Christopher[20] similarly reported that, in a group of 36 men who used a VED more than 50% of possible days during a 90-day period after catheter removal subsequent to RP, only one patient had a decrease in SPL of $\geq$1 cm. Three men had poor compliance to the use of the VED, and of these, two had a decrease in SPL greater than or equal to 1 cm.

Raina and associates[8] assessed the efficacy of a VED on EF in a group of patients who underwent either nerve-sparing or nonnerve-sparing RRP. Seventy-four patients were instructed to use a VED daily for 9 months; of these, 14 discontinued use after 3 months. A second group of 35 participants did not use any erectogenic treatment. Of the 60 subjects who successfully used the VED, 23% reported a decrease in penile length and circumference at the end of 9 months, while 85% of the subjects who stopped using the VED reported a reduction in penile parameters. Sixty-three percent of patients who did not use a VED at any time during the study reported a decrease in penile length and circumference.

In this robotic cohort, there was a significant reduction in length at the earliest time point after surgery (1 month). Penile length was still reduced, but much less so, after 3 and 6 months. It is not known whether these reductions in length are associated with any significant function or psychological effects. By 9 months, there was no significant difference from

the preoperative penile length, and this was maintained at 10 and 11 months. At 11 months, 74% of men had SPL change less than 0.5 cm from baseline, and 92% of men had SPL change less than 1.5 cm from baseline. The mechanisms responsible for this recovery of penile length are unknown. PR (IUA and SC) may have facilitated recovery of penile length; however, the decreases in SPL seen in the combined multicenter study group appeared to remain consistent throughout the study.[12] We think that it is possible that differences in surgical technique may lead to decreased cavernous nerve injury and decreased corporal fibrosis.

Our study seems to suggest that SPL may simply be a surrogate measure of EF after prostatectomy, as was also observed in a similar study of SPL change after RRP. [18] The authors of that study suggest that excellent nerve-sparing technique will lead to absence of SPL change and a corresponding return of sexual function. Other potential mechanisms may include decreased urethral shortening, pelvic fibrosis, and the lack of incisional suprapubic scarring. Bladder neck contractures, which are often associated with anastomotic leak, pelvic hematoma, and fibrosis, are seen less frequently with RALRP.[15,21] Because there have been no randomized comparisons of the open and robotic procedures for RP, and this study was not designed to compare the two, we cannot draw any definite conclusions regarding the differences seen in this study and previous reports.

Our findings should be interpreted in the context of the study design. First, there were two observers who recorded penile length at the site of the robotic cohort. While there appeared to be little variability between these observers, it is possible that there was a discrepancy in the recorded values between the observers. We think that a greater limitation may have been variability between examiners and measurement technique between sites in the multicenter trial. For this reason, we think that a direct comparison was limited and therefore omitted this from the article.[22] Second, penile length was not assessed circumferentially or in the erect state, which may have provided different results. Finally, our study did not include a control group whereby no PR was given because of ethical concerns as well as difficulty with patient recruitment into a placebo-controlled trial of this nature. Therefore, the relative effect of rehabilitation, alone or in combination with the surgical technique, on the return of penile length cannot be definitively ascertained. Only a randomized controlled trial that compares RALRP patients' penile lengths with and without the use of PR would confirm our above findings.

Conclusion

This is the first study to describe penile length changes over time after RALRP for prostate cancer. Results demonstrated a modest decrease in penile length that was evident at the first postoperative visit at 1 month. There was still a significant difference in length at 3 and 6 months, although the reduction was not as great as at 1 month. By 9 months after surgery, penile length had returned to baseline. Patients should be counseled that penile length might decrease after RP. Additional study is needed to determine the mechanisms of shortening and recovery, as well as the impact on patients' quality of life, self-esteem, and sexual function.

Disclosure Statement

The authors acknowledge financial support from Vivus, Inc.

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Abbreviations Used

ED = erectile dysfunction
EDITS = Erectile Dysfunction Inventory of Treatment Satisfaction
EF = erectile function
IUA = intraurethral alprostadil
IIEF = International Index of Erectile Function
PR = penile rehabilitation
RALRP = robot-assisted laparoscopic radical prostatectomy
RP = radical prostatectomy
RRP = radical retropubic prostatectomy
SC = sildenafil citrate
SPL = stretched penile length
VED = vacuum erection device