

ORIGINAL ARTICLE

Preservation of penile length after radical prostatectomy: early intervention with a vacuum erection device

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Radical prostatectomy has been shown to have a potential negative impact on penile health. Stretched penile length (SPL), which most closely correlates with erect penile length, was significantly reduced in almost half of men undergoing surgery in several studies. The purpose of this study was to test whether early intervention after surgery with a vacuum erection device could prevent the changes in penile health, as defined by SPL, found in prior studies. Forty-two men with good preoperative sexual function undergoing nerve-sparing radical prostatectomy underwent measurement of SPL preoperative and at 3 months postoperative by a single investigator. Daily use of a vacuum erection device (VED) was begun the day after catheter removal, and continued for 90 days. Men kept a log of their compliance with daily VED use. A decrease in SPL of ≥ 1.0 cm was considered significant. Out of 42 men, 39 completed the study. In men who used the VED $> 50\%$ of possible days, only 1/36 (3%) had a decrease in SPL of ≥ 1.0 cm. Of the three men with poor VED compliance, two (67%) had a reduction in SPL of ≥ 1.0 cm. When compared to prior studies where 48% of men after surgery had a significant reduction in SPL, early intervention with the daily use of a VED resulted in a significantly lower risk of loss of penile length ($P < 0.0001$). For men wishing to preserve penile health/length after surgery, early intervention with the daily use of a VED should be strongly recommended.

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Introduction

All treatment for localized carcinoma of the prostate can have a negative impact on sexual health. Surgical treatment can result not only in the loss of erection function, but climacteria, painful orgasm and penile shortening. Penile shortening after surgery has been shown in several studies to be a fairly common event.^{1–3} In our initial study,¹ we found that at 3 months after surgery, 48% of men had significant penile shortening, as measured through stretched penile length (SPL). The purpose of the present study was to assess if early intervention after surgery with a vacuum erection device (VED) could prevent the reduction in SPL found in our initial study.

Methods

Between February and October 2006, 42 men were enrolled in our Institutional Review Board-approved study. Inclusion criteria required that men were undergoing nerve-sparing radical prostatectomy, and had stated on an anonymous preoperatively completed UCLA Prostate Cancer Index survey that they had erections adequate for intercourse without the use of any erectile dysfunction treatments. All men denied any history of Peyronnie's disease, or prior urethral, prostate or penile surgery.

Participants were given a VED package (provided by TIMM Medical Technologies, Inc., Eden Prairie, MN, USA) with an instruction sheet regarding use of the VED for study purposes (Appendix 1). VED was used daily; beginning the day after the urethral catheter was removed, and continued for 90 days. Participants were asked to track their daily compliance and report the results at their 3-month follow-up measurement.

As SPL most closely correlates with erect penile length,⁴ we chose SPL as our end point. SPL was defined as the distance from the pubo-penile skin

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junction to the urethral meatus with maximal manual extension of the penis by the investigator performing the measurement.⁴ A decrease in SPL of ≥ 1.0 cm was considered a significant reduction, and allowed comparison to the findings in our initial study. All measurements were performed using an unmarked paper ruler by the same investigator (BLD). Duplicate measurements were performed each time, and an average of the two was used as the final measurement. The initial measurements were performed 1–2 weeks before surgery in the investigators office in the supine position, and the final measurements in the same office and position within 3 days of the conclusion of the trial period.

A single surgeon (BLD) performed all the radical prostatectomy procedures. A 20-french urethral catheter was left in place postoperatively, with removal based on a cystogram demonstrating no evidence of an anastomotic leak obtained at post-operative day 10. If a leak was present, the catheter was removed later at the physician's discretion. All catheters were removed within 14 days of surgery.

The χ^2 test procedure used in conjunction with the Crosstabs function in SPSS tabulates the variable penile length against intervention and computes a χ^2 statistic. The goodness-of-fit test compares the observed and expected frequencies in each category to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

Results

The study enrolled 42 men. Three men were dropped from the study after initial measurement, one due to failure to complete the surgery because of previous bilateral pre-peritoneal mesh hernia repair precluding prostate removal, one due to early treatment with androgen ablation after surgery for lymph node positive disease and one man who failed to return at the appropriate point in time after surgery to obtain the 90-day measurement. In the remaining 39 men, compliance with VED use revealed that 32 men used the VED $\geq 90\%$ of possible days, four men at 50–90% of possible days, and three men at $<25\%$ of possible days.

The mean SPL preoperative was 12.7 cm (range 10.0–15.4 cm), and postoperative was 12.3 cm (range 9.9–15.4 cm) ($P>0.05$) (Table 1). Overall, 36/39 (92%) men maintained their SPL, while three men (8%) had reductions of ≥ 1.0 cm. The three men with significant shortening had changes of 1.3 cm (9% of total length), 1.8 cm (15% of total length) and 2.4 cm (17% of total length). Of importance, two of the three men with significant reductions in SPL had low compliance rates with the VED use, at 25

Table 1 Stretched penile length

Patient number	Preoperative	Postoperative
1	14.5/14.2	14.2/13.6
2	10.4/10.9	10.5/11.0
3	11.3/11.5	11.8/12.1
4	10.4/10.9	10.1/10.6
5	13.5/13.5	13.2/13.5
6	13.4/13.5	13.2/13.8
7	13.4/13.4	12.8/12.2
8	11.4/11.5	12.5/12.5
9	15.3/15.6	14.6/14.6
10	11.0/11.0	11.0/11.4
11	12.8/13.0	12.8/13.0
12	15.2/15.3	13.9/13.8**
13	13.0/13.3	13.0/12.3
14	10.9/10.9	10.7/11.0
15	11.8/12.1	11.6/12.0
16	12.6/12.3	12.6/13.0
17	14.6/15.0	14.8/14.2
18	12.6/13.4	12.2/13.1
19	11.5/11.3	11.4/12.0
20	10.1/9.2	9.5/10.2
21	13.3/13.2	12.8/12.9
22	12.4/12.9	13.2/13.4
23	12.0/12.4	11.4/11.0
24	13.4/13.8	13.6/14.2
25	14.5/14.5	12.0/12.2**
26	12.4/12.5	11.0/10.2**
27	11.4/10.9	12.0/11.2
28	15.6/16.0	14.8/16.0
29	11.7/11.4	12.1/12.5
30	12.6/13.2	13.0/13.6
31	12.5/12.8	13.4/13.4
32	12.4/13.5	13.8/12.8
33	12.8/13.4	13.2/13.6
34	14.5/14.6	15.2/15.1
35	10.4/11.0	12.0/11.5
36	14.7/14.7	15.0/13.8
37	15.0/15.2	14.5/16.0
38	11.1/11.8	11.2/11.4
39	14.0/14.2	14.0/13.6

All measurements are in centimeters.

**Decreased by >1.0 cm.

and 10% of possible days used. In men who were at least 50% compliant with the VED use, 35/36 (97%) maintained their SPL.

In our initial study,¹ 48% of men had a decrease in SPL of ≥ 1.0 cm. The 3% rate of SPL reduction for compliant men in the present study represents a significantly reduced risk of penile shortening with VED intervention ($P<0.0001$).

Discussion

Surgical treatment for localized carcinoma of the prostate, even with nerve-sparing surgery, can have a significant negative impact on sexual health. One clear result of surgery^{1–3} is the reduction in penile length seen in a large percentage of men. The exact cause(s) of this change is not clear, although is likely

multi-factorial as previously discussed in several publications.^{5,6} The ability to maintain penile health after surgery, such as in preserving SPL, may potentially impact on the ultimate recovery of erectile function as well.

We chose a VED intervention because of the non-invasive nature of the treatment, and the ability to restore maximal penile tumescence on a daily basis, most closely reproducing the spontaneous daily erections experienced in well-functioning potent men. Additionally, it has been shown that a VED initiates an arterial component to penile blood flow during treatment⁷ providing well-oxygenated blood, rather than simply venous distention, which may aid in preserving penile tissue health as well.

Initiating intervention early in the postoperative period may be critical, as neural injury has been shown to result in immediate cellular changes,^{8–10} which may contribute to future failure of penile recovery even with neural pathway healing. We therefore began penile rehabilitation immediately after catheter removal, using an intervention that could easily be performed even if patients had urinary incontinence issues, did not require an extended period of time each day and had no systemic sequelae.

A recent study¹¹ on VED use after surgery initiated treatment at an average time of 1 month after surgery (range 2–8 weeks), and did make some assessment of penile length. The intervention group was instructed to use the VED daily, and also as desired for intercourse. The authors found that the men who were able to use the VED for intercourse were less likely to feel their penis was shorter than those men unable to use the VED for intercourse (23 versus 85%). No measure of VED use compliance was obtained, no specific method of daily use was determined and no actual measurements of penile length were obtained. Given their study design, it is difficult to draw any definitive conclusions, except to support the belief that successful use and compliance with the VED intervention is likely important in preserving men's perception of their penile length.

Other investigators have studied the use of phosphodiesterase type 5 inhibitors (PDE-5) shortly after surgery in an effort to improve long-term sexual health recovery,¹² but no study with PDE-5 inhibitors has assessed preservation of penile length. If preservation of penile length after surgery requires significant arterial inflow to the penis, it appears unlikely that the use of PDE-5 inhibitors on a daily basis soon after surgery would prevent a loss in penile length, as the PDE-5 inhibitors uncommonly result in maximal tumescence in the early postoperative period.

A recent review of penile rehabilitation after radical prostatectomy nicely details the current status of the probable mechanisms of injury to sexual function after surgery, and the potential

interventions available to prevent or repair such injury.⁶ It seems that in men with good preoperative sexual health, undergoing well performed nerve-sparing surgery, penile rehabilitation will require early intervention with a multi-modal approach to preserve penile health, and aid in recovery of sexual function.

Our study design was strengthened by the use of a single individual to perform all measurements and the same site for pre- and postoperative testing. Also, the use of an unmarked ruler, and a database blinded to the investigator and patient, prevented any bias by either at the time of the pre- and postoperative measurements. Finally, we enrolled only men who had normal preoperative erection function based on an anonymously completed UCLA Prostate Cancer Index validated survey, so as to avoid men who may have already lost penile length through aging-related impotence, if such a loss does occur.

To be critical of our design, we had no control group except the prior study results using identical study design. We understood how difficult randomization to a non-intervention arm would be, having to discuss with potential participants the 48% risk of penile shortening seen in our initial study. We therefore proceeded with an intervention only study, using our prior study of essentially identical study design as a historical control. Another concern is that we did not include additional measurements such as the use of intracorporeal injection with color doppler flow changes, and measurements of penile volume, which can provide additional important information concerning penile health. We sought to maintain a non-invasive nature of our study, so as to avoid participant drop-out due to refusal to have pre- and postoperative invasive studies, although, future studies of penile rehabilitation mechanisms may require such investigation. Finally, we elected the 3-month time frame to correlate and compare to our initial study results. Although we found a significant improvement in preservation of SPL at 3 months in this early VED intervention study, it may require prolonged use of the VED, until adequate spontaneous erection function recovers, to preserve penile length/health in the long term. We routinely told all participants at their 3-month measurement that it may be best to continue the VED intervention indefinitely.

Conclusion

Reductions in penile length can be a common finding in men undergoing radical prostatectomy, regardless of the nerve-sparing nature of the surgery. Our study found that early intervention with the simple daily use of a VED prevented the penile length loss in almost all men compliant with the early intervention. To date, the best method for penile rehabilitation after

radical prostatectomy in order to preserve or assist in recovery of penile health has not yet been defined. Our findings strongly support a role for early intervention with the daily use of a VED in men wishing to preserve penile length, and potentially penile health, after surgical treatment for localized carcinoma of the prostate.

References

- Munding M, Wessells H, Dalkin B. Pilot study of changes in stretched penile length 3 months after radical retropubic prostatectomy. *Urology* 2001; **58**: 567–569.
- Savoie M, Sandy S, Soloway M. A prospective study measuring penile length in men treated with radical prostatectomy for prostate cancer. *J Urol* 2003; **169**: 1462–1464.
- Fraiman M, McCullough A, Lepor H. Changes in penile morphometrics in men with erectile dysfunction after nerve-sparing radical retropubic prostatectomy. *Mol Urol* 1999; **3**: 109–115.
- Wessells H, Lue T, McAninch J. Penile length in the flaccid and erect states: guidelines for penile augmentation. *J Urol* 1996; **156**: 995–997.
- Mulhall JP. Penile length changes after radical prostatectomy. *BJU Int* 2005; **96**: 472–473.
- Dall'Era J, Mills J, Koul H, Meacham R. Penile rehabilitation after radical prostatectomy: important therapy or wishful thinking? *Rev Urol* 2006; **8**: 209–215.
- Bosshardt R, Farwerk R, Sikora R, Sohn M, Jakse G. Objective measurement of the effectiveness, therapeutic success and dynamic mechanisms of the vacuum device. *Br J Urol* 1995; **74**: 786–791.
- Carrier S, Zvara P, Nunes L, Kour NW, Rechman J, Lue T. Regeneration of nitric oxide synthase-containing nerves after cavernous nerve neurotomy in the rat. *J Urol* 1995; **153**: 1722–1777.
- Klein L, Miller M, Buttyan R, Raffo AJ, Burchard M, Devris G *et al.* Apoptosis in the rat penis after penile denervation. *J Urol* 1997; **158**: 626–630.
- User H, Hairston JZelner D, McKenna K, McVary K. Penile weight and cell subtype specific changes in a post-radical prostatectomy model of erectile dysfunction. *J Urol* 2003; **169**: 1175–1179.
- Raina R, Agarwal A, Ausmundson S, Lakin M, Nandipati KC, Montague DK *et al.* Early use of the vacuum constriction device following radical prostatectomy facilitates early sexual activity and potentially earlier return of erectile function. *Int J Impot Res* 2006; **18**: 77–81.
- Padma-Nathan H, McCullough A, Giuliano F, Toler S, Wohlhuter C, Shpilsky A *et al.* Postoperative nightly administration of sildenafil citrate significantly improves the return of normal spontaneous erectile function after bilateral nerve-sparing radical prostatectomy (abstract 1402). *J Urol Vol* 2003; **169**: 375.

Appendix 1

Penile health study: use of the VED

- Assemble the handle to the tube with the writing on the tube facing up, and the lever on the handle facing down.
- Put lubricant in the bottom of the tube where your penis will be, then around the outside edge of the tube where it will contact your skin.
- You may need to trim the pubic hair at the base of the penis to give a better seal for the tube.
- Use the pump either standing up or sitting forward on the edge of a chair to allow the scrotum skin to hang down out of the way.
- Gently but firmly compress the tube against yourself to create a nice seal to then begin pumping.
- Begin pumping by compressing the handle once every several seconds to allow for a slow engorgement of the penis.
- Continue until the penis is fully engorged, usually when it elevates off the floor of the cylinder and is in the middle of the tube.
- Leave the penis fully engorged inside the pump for 5 min. Then let the penis deflate fully for 1–2 min and repeat to full engorgement for another 5 min.
- Perform daily beginning the day after your catheter is removed from your bladder.
- There is a safety regulator in the system that prevents you from creating too much pressure to injure yourself.

Feel free to use the VED for sexual intercourse as well. This involves the use of the constriction bands, which is reviewed in the manual with the VED.