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Efficacy of a Novel Penile Traction Device in Improving Penile Length and Erectile Function Post Prostatectomy: Results from a Single-Center Randomized, Controlled Trial

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Full length article available at www.auajournals.org/doi/10.1097/JU.0000000000001792.

Study Need and Importance: Despite nerve-sparing techniques, erectile dysfunction and subjective penile length loss remain challenging adverse effects post prostatectomy. Several therapies have been investigated to improve these symptoms, including phosphodiesterase-5 inhibitors (PDE5s), intracavernosal injections (ICIs), and vacuum devices; however, none has improved or preserved spontaneous erectile function in high level studies. RestoreX is a novel penile traction therapy (PTT) device which previously demonstrated increases in penile length in a randomized, controlled trial (RCT) after 30–90 minutes of daily use, compared to 3–9 hours with traditional devices. Additionally, results unexpectedly demonstrated significant improvements in erectile function. Given these findings, we sought to investigate its use in men undergoing prostatectomy.

What We Found: Results from this RCT demonstrated that use of the novel PTT device beginning 1 month post prostatectomy through 6 months increased penile length by 1.6 cm and preserved erectile function compared to controls. Men in the PTT group also used fewer erectogenic aids (PDE5s or ICIs) and had better intercourse and overall sexual satisfaction on standardized questionnaires. Importantly, these results are the first to demonstrate improved preservation of spontaneous erectile function of any therapy post prostatectomy. Findings were also consistent with a prior RCT performed in men with Peyronie's disease and a recently completed RCT in men with diabetes (results currently in abstract only).

Limitations: Key limitations include the lack of a viable sham device, single center, and inability to blind investigators or participants. It is also notable that the PTT device was developed at the Mayo Clinic, although it is unclear if/how this would bias standardized questionnaire responses.

Interpretation for Patient Care: Men undergoing prostatectomy may be treated with a novel PTT device 30–60 minutes daily beginning at 1 month and continuing until at least 6 months to help preserve penile length and erectile function.

0022-5347/21/2062-0416/0
THE JOURNAL OF UROLOGY®

https://doi.org/10.1097/JU.0000000000001792
Vol. 206, 416-426, August 2021
Printed in U.S.A.

THE JOURNAL of UROLOGY®
www.auajournals.org/journal/juro

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Efficacy of a Novel Penile Traction Device in Improving Penile Length and Erectile Function Post Prostatectomy: Results from a Single-Center Randomized, Controlled Trial

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Purpose: RestoreX is a novel penile traction therapy device, with randomized, controlled data demonstrating improvements in penile length and erectile function after 30 to 90 minutes of daily use in men with Peyronie's disease. We sought to determine if similar improvements could be achieved post prostatectomy.

Materials and Methods: Men post prostatectomy were randomly assigned to control or one of 2 penile traction therapy protocols for 6 months, followed by a 3-month open-label phase. The current study presents data from the randomized phase. The primary outcome was changes in stretched penile length; secondary outcomes were changes in International Index of Erectile Function (IIEF) scores, adverse events, satisfaction and subjective measures.

Results: In all, 82 men (mean age 58.6 years) were randomized, with 6-month data available in 25 controls and 30 penile traction therapy cases. At 6 months, penile traction therapy achieved greater improvements/preservation of penile length (+1.6 vs +0.3 cm, p <0.01), erectile function (IIEF-Erectile Function +0 vs −6.5, p=0.03), intercourse satisfaction (IIEF-Intercourse Satisfaction +1 vs −3.5, p <0.01) and overall sexual satisfaction (IIEF-Overall Sexual Satisfaction 0 vs −3, p <0.01). Erectogenic therapy use was lower in penile traction therapy men (phosphodiesterase-5 inhibitors 86% vs 94%, p=0.44; intracavernosal injections 19% vs 50%, p <0.05). More penile traction therapy men reported satisfaction or improvement in penile length than controls. Adverse events were transient and mild; 87% would choose to repeat therapy, and 93% would recommend it to others.

Conclusions: The use of a novel penile traction therapy device results in significant improvements in objective and subjective penile length post prostatectomy and measures of erectile function, intercourse satisfaction and overall sexual satisfaction. External validation is warranted.

Abbreviations and Acronyms

AE = adverse event
ED = erectile dysfunction
EFD = erectile function domain
ICI = intracavernosal injection
IIEF = International Index of Erectile Function
PD = Peyronie's disease
PDE5 = phosphodiesterase-5 inhibitor
PTT = penile traction therapy
RCT = randomized, controlled trial
SEP = sexual encounter profile
VED = vacuum erection devices

Key Words: prostatectomy, erectile dysfunction, penile induration, traction, rehabilitation

Accepted for publication March 26, 2021.

Supported by PathRight Medical through the Mayo Clinic to LT as a function of royalty sharing agreements established by Mayo Clinic.

All funding for the current study was provided by internal funds, with the exception of RestoreX devices, which were provided by PathRight Medical at no charge.

* Financial and/or other relationship with Paradigm Medical Communications.

† Financial and/or other relationship with Johnson & Johnson.

‡ Financial and/or other relationship with Ferring, FerGene and ArTara.

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0022-5347/21/2062-0417/0
THE JOURNAL OF UROLOGY®

https://doi.org/10.1097/JU.0000000000001792
Vol. 206, 416-426, August 2021
Printed in U.S.A.

THE treatment of prostate cancer results in several notable impacts on male sexual function, including reductions in perceived or actual penile length, erectile dysfunction, ejaculatory/orgasmic dysfunction and increased incidence of Peyronie's disease, among others.[1–5] The introduction of nerve-sparing techniques with radical prostatectomy has significantly improved erectile function outcomes, yet ED remains a common and bothersome adverse event in contemporary series.[6]

Several investigators have evaluated various therapies and "penile rehabilitation" protocols to improve erectile function. The primary goals of penile rehabilitation have traditionally been to improve/preserve penile morphology and erectile function postoperatively to prevent penile fibrosis.[7] Treatment protocols commonly include phosphodiesterase-5 inhibitors, intracavernosal injections and/or vacuum erection devices. Despite multiple attempts, all high-level randomized, controlled trials to date have reported failures of any therapy to preserve/improve spontaneous erectile function.[8–10] Similarly, a recent RCT evaluating a specific penile rehabilitation protocol closed early due to poor accrual and demonstrated no benefits with PDE5s and ICI on improving spontaneous erectile function (NCT 00955929; limited results available).[11]

Beyond VEDs, penile traction therapy represents another form of mechanical therapy which is commonly used to correct curvature and increase penile length. Despite its frequent use with PD, to date no studies have evaluated the efficacy of PTT in preserving/increasing penile length in men post prostatectomy. One key limitation which has precluded widespread adoption of traditional PTT devices is the requirement for 2 to 9 hours of daily use to achieve benefits. Recently, a novel PTT device, RestoreX (PathRight Medical, Plymouth, Minnesota) was developed as a second generation therapy with notable changes to the clamp mechanism, force delivered and ability to dynamically increase traction. Possibly due to these changes, PTT was shown to increase penile length and curvature with 30 minutes of daily use.[12] Results of the RCT also showed statistically and clinically significant improvements in erectile function among treated men compared to controls.

Given these data and the sexual comorbidities associated with prostatectomy, we sought to investigate the efficacy of PTT in men post prostatectomy. Specifically, we hypothesized that the use of PTT post prostatectomy would result in improved penile length and erectile function compared to untreated controls. Additionally, we sought to investigate differences in efficacy using one of 2 different treatment protocols.

MATERIAL AND METHODS

Study Protocol and Design

Following institutional review board approval (IRB No. 18-001013), a randomized, controlled trial (NCT03500419) was conducted in 2 phases to evaluate the efficacy of PTT in improving penile length and sexual function in men post prostatectomy (fig. 1). The first phase involved randomizing men 1:1:1 to 1) no treatment (Control), 2) PTT 30 minutes/day × 5 days/week (PTT A—low dose), or 3) PTT 30 minutes, 2 times/day × 7 days/week (PTT B—high dose). Funding was provided using internal funds, and devices were donated by PathRight Medical.

Treatments were performed using straight traction only (ie no counter-bending) with dynamic adjustments performed to assure ongoing traction per manufacturer recommendations. Treatments were initiated 1-month post prostatectomy and continued for 5 months. Patients then entered an open label phase where they could choose to begin, continue or stop treatment for an additional 3 months. The current study reports outcomes of the 6-month randomized phase.

A power analysis was performed to detect a 1 cm difference in penile length at 6 months with 80% power (standard deviation 1.1 based on prior RCT data).[12] Results indicated a need for 41 patients with 6-month data, and the decision was made to enroll 20 men in each arm based on completion rates from the previously cited RCT. An interim analysis demonstrated a higher number of missing 6-month data points than anticipated, and additional patients were enrolled to assure a minimum of 41 patients with 6-month data.

Randomization

To assure equal distributions of men with differing penile lengths, randomization tables were created a priori using baseline stretched lengths of <10, 10−13, 13.1−16, and >16 cm. Inclusion criteria were men >18 years of age undergoing prostatectomy for prostate cancer. Exclusion criteria were men who experienced significant urethral complications post prostatectomy such as anastomotic dehiscence. All patients underwent surgery at the Mayo Clinic.

Primary and Secondary Outcomes

The primary outcome variable was change in stretched penile length at 6 months between control and PTT men (combined grouping). Secondary outcomes included differences between control and PTT men (combined) in IIEF subdomain scores, AEs, satisfaction with penile length, Sexual Encounter Profile questions 2 and 3 scores, and the use of phosphodiesterase-5 inhibitors and intracavernosal injection therapies. Other secondary outcomes included patient satisfaction and tolerability of PTT, compliance with therapy, and differences in length and measures of sexual function between PTT treatment groups (PTT A vs B). The combined grouping was defined a priori to provide sufficient power and based on preliminary data from prior RCTs of PTT which demonstrated minimal differences between groupings. However, subgroups were designed into the study with the intent of informing future studies, evaluate for "signals" suggesting potential differences, and to evaluate compliance in the prostatectomy population.

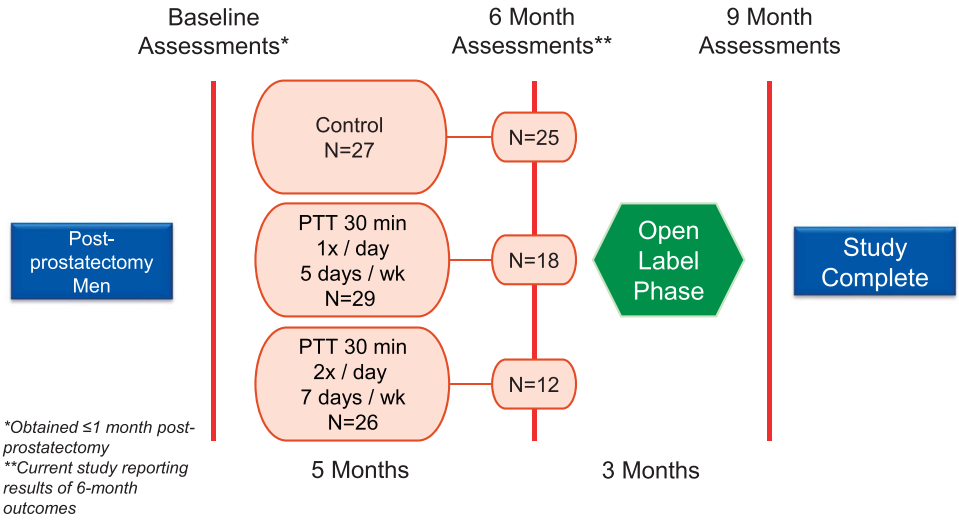

Figure 1. Overview of study protocol. Note that current study reports outcomes of 6-month assessment.

Following prostatectomy, men were not specifically counseled as to postprostatectomy use of PDE5s or ICI therapies; however, patients were permitted to use these treatments if desired. Data on PDE5 and ICI use were captured before and at 6 months to compare differences in utilization. Men were not permitted to use any other form of PTT or VED to limit confounders. All patients underwent surgery by one of 5 highly experienced prostatectomy surgeons with the goal of performing bilateral nerve preservation if clinically appropriate.

Outcome Measures

Baseline assessments were performed within the first month post prostatectomy and included objective measures of penile length (measured pubic symphysis to corona and tip), demographic and disease characteristics, and standardized and nonstandardized questionnaires, including subjective ED, curvature, and length assessments, use of PDE5 inhibitors, and the IIEF. Penile length was measured by 2 assessors who were blinded to prior results and grouping. Assessments at 6 and 9 months additionally included the Sexual Encounter Profile questions 2 and 3 (SEP-2, SEP-3), global assessment questions on improvements in erectile and sexual function and satisfaction with therapy. Additionally, adverse events were recorded including location, symptom and time to resolution. Patients who were assigned to PTT also completed treatment diaries to track daily use.

Statistics

All data were analyzed using an intent-to-treat protocol, with no outliers excluded or missing data replaced to optimize data integrity. Statistical analyses were performed using JMP 14.2.0 (SAS Institute, Minneapolis, Minnesota). Normally distributed data were reported as means and standard deviations, while nonnormally distributed data with skewed distributions were reported as medians and interquartile ranges. ANCOVA was used when variables included both baseline and 6-month assessments (eg length, IIEF). Other statistical tests included Student's t-test, Wilcoxon Rank Sum, and chi-squared analyses depending on data type. Two-tailed p values of <0.05 were considered statistically significant.

RESULTS

A total of 82 men were enrolled from April 2018 through February 2020, with 6-month data available in 25 controls, 18 PTT A, and 12 PTT B. Mean weekly PTT utilization (over 20 weeks) was 90.1 and 148.0 minutes for PTT A and B, respectively. Baseline demographics are shown in table 1 and demonstrate similarities in all clinical and pathological variables, with the exception of preoperative prostate specific antigen, which was slightly higher in the PTT treatment groups (7.7 vs 5.1, $p<0.01$). Baseline measures were obtained at a median of 8 days postoperatively (IQR 7, 13), with patients specifically counseled to answer questionnaires based on preoperative function.

The primary outcome demonstrated statistically greater improvements in penile length among men treated with PTT compared to controls ($+1.6$ cm vs $+0.3$ cm, $p<0.01$) measured to corona. Findings were similar using measurements to the penile tip ($+1.6$ cm vs $+0.7$ cm, $p=0.01$). Percent improvements ranged from 10.6% to 14.3% in the treatment arm compared to 3.5% to 5.0% in controls ($p<0.001$ to 0.03). Subjective assessments of penile length were also in favor of PTT, with 56% vs 13% reporting satisfaction with length ($p<0.001$), and 56% vs 0% reporting improvements in length ($p<0.0001$).

Erectile function was also preserved/improved at greater rates among men treated with PTT compared to controls. The median change in the IIEF erectile function domain (IIEF-EFD) was 0 points for PTT vs -6.5 points for controls ($p=0.03$), with results achieving the minimally clinically significant difference (4 points).[13] Indirect measures were also suggestive of maintained/improved erectile function, with SEP-2 and SEP-3 nonstatistically higher in PTT

Table 1. *Patient baseline demographics, clinicopathological and surgical variables*

	PTT Combined	Control	p Value
	Baseline Demographics		
No. pts*	55	27	
Mean age (SD)	58.7 (6.8)	58.2 (4.5)	0.66
Median IIEF (IQR):			
EFD	26.5 (9, 30)	28 (14, 30)	0.36
Orgasmic function domain	10 (4.8, 10)	10 (8, 10)	0.19
Sexual desire domain	7 (5, 9)	9 (6, 10)	0.10
Intercourse satisfaction domain	10 (0, 13)	11 (5, 13)	0.18
Overall satisfaction domain	8 (6, 10)	9 (5.8, 10)	0.45
No. ED categorization (%):†			0.53
None	30 (55.6)	15 (55.6)	
Mild	7 (13.0)	4 (14.8)	
Moderate	2 (3.7)	3 (11.1)	
Severe	15 (27.8)	5 (18.5)	
Self-reported ED:			
No. (%)	21 (38.2)	10 (37.0)	0.92
Median mos duration of ED (IQR)	24 (12, 66)	32 (24, 84)	0.57
No. use of PDE5 within past yr (%)	11 (20.0)	9 (33.3)	0.19
No. use of ICI within past yr (%)	0 (0)	1 (3.7)	0.13
No. self-reported preop curvature (%)	9 (16.3)‡	5 (19.2)§	0.76
No. self-reported preop penile length loss (%)	8 (14.8)†	4 (15.4)§	0.95
Median cm estimated amount of length loss (IQR)	1 (0.6, 2.4)	1 (0.6, 1.4)	0.66
Mean body mass index (SD)	29.7 (4.5)	29.3 (3.9)	0.71
No. race (%):			0.47
White	48 (87)	25 (93)	
Black	4 (7)	1 (4)	
American Indian/Alaskan Native	1 (2)	0 (0)	
Other/unknown	2 (4)	1 (4)	
	Surgical and Pathological		
Median preop PSA (IQR)	7.7 (5.5, 10.7)	5.1 (4, 8.1)	**< 0.01**
No. perineural invasion on biopsy (%)	9 (16.4)	6 (22.2)	0.55
No. robotic vs open approach (%)	55 (100)	26 (96.3)	0.13
No. Gleason score (%):			0.41
3+3	4 (7.3)	5 (18.5)	
3+4	32 (58.2)	17 (63.0)	
4+3	2 (3.6)	0 (0)	
4+4	11 (20.0)	3 (11.1)	
4+5	1 (1.8)	0 (0)	
5+4	4 (7.3)	2 (7.4)	
5+5	1 (1.8)	0 (0)	
No. pathological stage (%):			0.27
T2	43 (78.2)	24 (88.9)	
T3a	8 (14.6)	1 (3.7)	
T3b	4 (7.3)	2 (7.4)	
No. pathological node status (%):			0.21
Nx	10 (18.1)	8 (29.6)	
N0	42 (76.3)	19 (70.4)	
N1	3 (5.5)	0 (0)	
No. metastatic disease pos (%)	2 (3.6)	0 (0)	0.20
No. surgical margin pos (%)	11 (20.4)†	6 (22.2)	1.00
No. nerve sparing (%):			0.51
None	1 (1.8)	0 (0)	
Unilat	5 (9.1)	4 (14.8)	
Bilat	49 (89.1)	23 (85.2)	
No. ADT within 6 mos of surgery (%)	2 (4.0)‖	0 (0)	0.19
No. radiation within 6 mos of surgery (%)	1 (2.0)	0 (0)	0.35
No. biochemical recurrence at last followup (%)	6 (12.0)‖	2 (7.4)	0.52

Wilcoxon tests utilized for continuous, data with a skewed distribution, Student's T-tests for continuous, normally distributed data, and Fisher's Exact and Likelihood ratio tests for categorical variables. Bolded item signifies statistical significance.
* Number of participants unless otherwise indicated.
†In 54 patients.
‡In 55 patients.
§ In 26 patients.
‖ In 50 patients.

men, and lower rates of PDE5 and ICI use observed ($p=0.44$ for PDE5s, <0.05 for ICI). Statistically significant improvements were also noted in the intercourse satisfaction and overall satisfaction domains of the IIEF (both $p<0.01$), while no changes were noted in the orgasmic and sexual desire domains. A post hoc power analysis was performed on differences in IIEF-EFD scores and demonstrated 84% power to detect a difference of 4 points between groups, suggesting that current findings are likely reliable. Figure 2

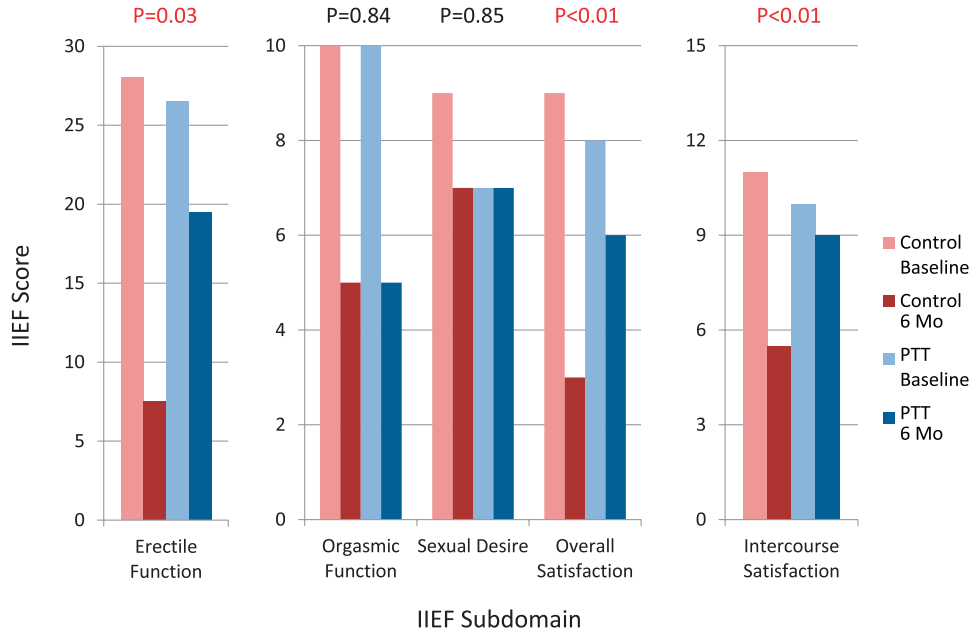

Figure 2. Baseline and 6-month results of IIEF domains between controls and men treated with novel PTT device. Note that values used in figure were obtained using median result from groups at baseline and 6 months. Values from table 2 were obtained by subtracting baseline from 6-month results; p value refers to comparison between groups after controlling for baseline values (ANCOVA).

demonstrates baseline and 6-month median values for various IIEF subdomains between control and PTT-treated men.

Patient satisfaction was also high, with respondents rating the PTT treatment 8/10 (10=extremely satisfied). A total of 93% indicated that they would recommend it to a friend, and 87% noted that they would utilize PTT post prostatectomy if they could redo therapy; 84% of treated men also reported that treatment resulted in a meaningful improvement overall. Table 2 reports key outcomes between controls and PTT-treated men.

A separate analysis was performed of the 2 differing treatment protocols for PTT (PTT A vs B; table 3). Results showed no statistically significant differences between groups regarding penile length or erectile function, with the exception of orgasmic and intercourse satisfaction domains, which were higher in PTT B men (longer treatment protocol).

Adverse events were similar to previously published series of PTT and demonstrated mild, transient changes with penile erythema, discomfort and sensory changes in 20.0%, 36.7%, and 10.1% of men, respectively (table 4).[12,14] One patient experienced symptoms >24 hours, with subsequent resolution over the following days, while all others resolved within minutes of discontinuing treatment. One patient in the PTT treatment group reported de novo penile curvature consistent with PD vs none in the control arm (p=0.32).

DISCUSSION

The current study reports outcomes of 2 different protocols of PTT used in the early postprostatectomy setting. Key findings include statistically significant improvements in penile length and clinically relevant preservation of erectile function compared to controls. These findings are important, as they represent the first treatment reported to achieve these 2 outcomes in men post prostatectomy. Similarly, it represents the first therapy shown in a high-level study to preserve spontaneous erectile function in men post prostatectomy (described in greater detail below). There were no notable differences in outcomes between treatment protocols, suggesting that the device may be effectively used for 30 minutes daily × 5 days weekly (mean duration of use in the current study was about 90–150 minutes weekly). Overall satisfaction for the treatment was high, and the device was well tolerated with no dropouts secondary to AEs.

The preservation of erectile function post prostatectomy has been a key objective for prostate cancer surgeons for decades. Since the introduction of nerve-preserving prostatectomy, there have been no additional treatments that have been shown to successfully preserve erectile function in randomized, placebo-controlled settings.[6] Two notable RCTs evaluating the efficacy of vardenafil or tadalafil to preserve erectile function (penile rehabilitation) failed to demonstrate any improvements following drug washout.[8,9] Similarly, no RCTs have been successfully completed of ICI, intraurethral suppositories or

Table 2. *Key outcomes from objective and standardized questionnaires at 6 months post prostatectomy (post-randomization phase)*

	PTT Combined	Control	p Value*
No. pts	30	25	
Objective Assessments			
Change in length, cm:			
No. pts	26	25	
To tip, mean (SD)	1.6 (1.0)	0.7 (1.5)	**0.01**
To tip, % (SD)	10.6 (7.1)	5.0 (9.7)	**0.03**
To corona, mean (SD)	1.6 (1.0)	0.3 (1.5)	**< 0.01**
To corona, % (SD)	14.3 (9.1)	3.5 (10.1)	**< 0.001**
No. use of PDE5 (%)/Total No.	18 (86)/21	15 (94)/16	0.44
No. use of ICI (%)/Total No.	4 (19)/21	8 (50)/16	**< 0.05**
Standardized Questionnaires			
IIEF:†			
No. pts	29	24	
Median change from baseline (IQR):‡			
No. EFD (all-comers)	0 (−7.5, 4)	−6.5 (−21.5, −2)	**0.03**
EFD (baseline ED: IIEF-EFD ≤25)	+5 (0, 14.5)	−6 (−14.5, −0.5)	0.28
Orgasmic function domain	−2 (−5, 0)	−4 (−7, 0)	0.84
Sexual desire domain	0 (−1, 1.5)	−1 (−2, 0.5)	0.85
Intercourse satisfaction domain	+1 (−2, 7)	−3.5 (−7, 0)	**< 0.01**
Overall satisfaction domain	0 (−2.8, 0.8)	−3 (−6, −1)	**< 0.01**
No. SEP-2 (%)/Total No.	20 (77)/26	13 (65)/20	0.51
No. SEP-3 (%)/Total No.	17 (68)/25	10 (53)/19	0.36
Additional Subjective Responses			
No. satisfaction with penile length (%)/Total No.:			**< 0.001**
Very satisfied	8 (30)/27	0 (0)/23	
Somewhat satisfied	7 (26)/27	3 (13)/23	
Neutral	9 (33)/27	10 (43)/23	
Somewhat dissatisfied	3 (11)/27	6 (26)/23	
Very dissatisfied	0/27	4 (17)/23	
No. improvement in length (%)/Total No.:			**< 0.0001**
Yes	15 (56)/27	0 (0)/16	
No	3 (11)/27	13 (81)/16	
Worse	1 (4)/27	1 (6)/16	
Unsure	8 (30)/27	2 (13)/16	
Estimated % improvement in length (IQR)/Total No.	17.5 (10, 26.3)/18	NA	NA
No. categorical estimated length improvement (%)/Total No.:		NA	NA
Large	3 (16.7)/18		
Medium	10 (55.6)/18		
Small	5 (27.8)/18		
No. "How does your FLACCID length compare with that prior to surgery?" (%)/Total No.:			**< 0.01**
Much shorter	0 (0)/27	4 (23.5)/17	
Slightly shorter	6 (22.2)/27	6 (35.3)/17	
Same	14 (51.9)/27	7 (41.2)/17	
Slightly longer	7 (25.9)/27	0 (0)/17	
Much longer	0 (0)/27	0 (0)/17	
No. "How does your ERECT length compare with prior to surgery?" (%)/Total No.:			0.39
Much shorter	1 (4.6)/14/22	3 (21.4)/14	
Slightly shorter	5 (22.7)/14/22	4 (28.6)/14	
Same	9 (40.9)/14/22	4 (28.6)/14	
Slightly longer	7 (31.8)/14/22	3 (21.4)/14	
Much longer	0 (0)/14/22	0 (0)/14	
No. "Has the therapy overall resulted in a meaningful improvement?" (%)/Total No.:		NA	NA
Yes	21 (84.0)/25		
No	4 (16.0)/25		
Median satisfaction with RestoreX on 1—10 scale (IQR)/Total No.§	8 (7, 9)/29	NA	NA
Median comfort with RestoreX on 1—10 scale (IQR)/Total No.‖	7 (5, 8)29	NA	NA
No. would recommend RestoreX to friend (%)/Total No.:		NA	NA
Recommend	28 (93)/30		
Indifferent	2 (7)/30		
Discourage	0 (0)/30		
No. would choose to use RestoreX post prostatectomy (%):		NA	NA
Yes	26 (87)/30		
Unsure	4 (13)/30		
No	0 (0)/30		

NA = not applicable.

* ANCOVA used to detect significance for length and IIEF, Wilcoxon tests utilized for continuous data with a skewed distribution, Student's T-tests for continuous, normally distributed data, Fisher's Exact tests for categorical variables, and Likelihood ratio if single cells <5. Bolded items signify statistical significance.

† Values used in this table for the IIEF were obtained by subtracting baseline from 6-month values. In contrast, values in figure 2 were obtained using the median result from the groups at baseline and 6 months.

‡ Negative denotes loss of function.

§ Where 10 = extremely satisfied.

‖ Where 10 = most comfortable.

Table 3. *Key outcomes from objective and standardized questionnaires at 6 months postprostatectomy by subgroup (postrandomization phase)*

	Control	PTT (30 min/day, 5 days/wk)	PTT (60 min/day, 7 days/wk)	p Value between PTT Groups*
No. pts	25	18	12	
Mean cm change in length (SD)/Total No.:				
To tip	0.7 (1.5)/25	1.7 (1.0)/16	1.3 (0.9)/10	0.46
To corona	0.3 (1.5)/25	1.7 (1.1)/16	1.6 (0.8)/10	0.83
Median change IIEF from baseline (IQR)/Total No.:†,‡				
EFD	−6.5 (−21.5, −2)/24	−0.5 (−10.8, 3.5)/18	0 (−6, −5)/11	0.26
Orgasmic function domain	−4 (−7, 0)/24	−5 (−7, 0)/18	0 (−2.5, 0.8)/11	**< 0.01**
Sexual desire domain	−1 (−2, 0.5)/24	0 (−1, 1.3)/18	0 (−1, 2)/11	0.11
Intercourse satisfaction domain	−3.5 (−7, 0)/24	0.5 (−4, 4)/18	1 (−1, 8)/11	**0.03**
Overall satisfaction domain	−3 (−6, −1)/24	0 (−3, 0)/18	0 (−2, 1)/11	0.30
No. SEP 2 (%)/Total No.	13 (65.0)/20	13 (81.3)/16	7 (70.0)/10	0.51
No. SEP 3 (%)/Total No.	10 (52.6)/19	10 (62.5)/16	7 (77.8)/9	0.42
No. use of PDE5 (%)/Total No.	15 (93.8)/16	10 (83.3)/12	8 (88.9)/9	0.72
No. use of ICI (%)/Total No.	8 (50.0)/16	3 (25.0)/12	1 (11.1)/9	0.41

* ANCOVA used to detect significance for length and IIEF, Wilcoxon tests utilized for continuous data with a skewed distribution, Student's T-tests for continuous, normally distributed data, Fisher's Exact tests for categorical variables, and Likelihood ratio if single cells <5. Bolded items signify statistical significance.
† Negative denotes loss of function.
‡ Note that values used in this table for the IIEF were obtained by subtracting baseline from 6-month values. In contrast, values in figure 2 were obtained using the median result from the groups at baseline and 6 months.

topical therapies in men post prostatectomy. Among devices, 1 pilot RCT was performed of 28 men post prostatectomy who were randomized to either VED or control.[10] Results demonstrated improved IIEF scores in VED men; however, these were measured only while using the VED, and no data were presented on spontaneous erections without concomitant VED.

Given the above data, to our knowledge, the current study represents the first RCT of any therapy which has demonstrated improved spontaneous erections without need for concomitant medications or other treatments immediately preceding intercourse. Additionally, results demonstrated a median difference between groups of 6.5 points, which is above the accepted threshold of 4 points to indicate a clinically significant difference.[13] These findings are further supported by the decreased use of PDE5s (nonstatistically significant) and ICI (significant), higher SEP-2 and SEP-3 scores (nonsignificant), and higher intercourse and overall satisfaction scores in the IIEF subdomains (significant) among PTT men compared to controls. If validated in external series, these data would represent a notable advancement in the management and prevention of postprostatectomy sexual dysfunction.

Table 4. *Adverse events reported at 6 months post prostatectomy (post-randomization phase)*

	No. PTT Combined (%)	No. Controls
Total No. pts	30	25
Temporary penile erythema or discoloration	6 (20.0)	NA
Temporary mild penile discomfort	11 (36.7)	NA
Temporary mild sensation changes	3 (10.1)	NA
Any AE	14 (46.8)	NA
Medium-term (>24 hrs) penile erythema, discomfort or sensory changes	1 (3.3)	NA
Long-term (persistent 3 mos later) penile erythema, discomfort or sensory changes	0	NA
De novo penile indentation or curvature	1 (3.3)*	0*

NA = not applicable.
* p = 0.32 comparing between PTT combined and controls.

Improvements in erectile function were also observed in a RCT evaluating the efficacy PTT in men with PD.[12,14] As with the current study, improvements achieved the minimally clinically significant threshold and provide further supporting evidence for an impact of therapy on erectile function. Although the exact mechanism for these improvements is unknown, potential explanations could include tensile-force mediated release of nitric oxide and upregulation of nitric oxide synthase, as demonstrated in animal models and human vascular studies, or diminished fibrosis (ie preserved penile length) leading to lower rates of venous leak.[15–17]

Findings from the current study are the first to report statistically significant increases in penile length among men post prostatectomy and demonstrated a mean 1.6 cm increase. Results are consistent with other RestoreX PTT studies which have shown improvements ranging from 1.3–2.3 cm in other cohorts.[12,14,18] This contrasts with the previously cited VED RCT, where no statistically significant increase in length was noted in the VED arm compared to baseline.[10] Interestingly, in the current study, control men were found to have no changes in objective penile length (+0.3 cm) after 6 months, despite 59% reporting subjective losses, consistent with other reports.[19]

The current study has several limitations, including its single-center design and lack of a viable sham. Additionally, the lead author was the inventor of the novel device at the Mayo Clinic, where the study was conducted. The number of participants without 6-month data and differing dropout rates

among groups may also introduce bias (33% with missing data). Several key challenges likely contributed to the missing data, including travel restrictions from COVID-19, the interstate/international nature of the prostate cancer practice, requirement that data be captured within 1 month of the planned return date, and lack of incentive for treatment patients to return (ie already received device), among others. It is important to recognize that the mean age of study participants was 59 years, which should be taken into account when extrapolating findings to other populations. Despite these limitations, the current study has several strengths, including its randomized, controlled design, a priori establishment of outcomes, use of standardized instruments, inclusion of all data points (no exclusions), intent-to-treat design, adequate study power, and blinded objective measures obtained in duplicate.

CONCLUSIONS

The use of a novel PTT device 30 to 60 minutes daily for 5–7 days per week post prostatectomy results in increased penile length, preserved erectile function, and improved intercourse and overall sexual satisfaction. Subjective measures also demonstrate high patient satisfaction and tolerance of therapy with mild, transient AEs. Pending external validation, PTT would represent the first treatment in post-prostatectomy men shown with high-level data to improve spontaneous erectile function, penile length, and overall sexual satisfaction without requiring use of an on-demand therapy.

ACKNOWLEDGMENTS

The authors wish to acknowledge the generous gift from a patient, who wishes to remain anonymous, that has facilitated Peyronie's disease research. The authors also wish to acknowledge the significant work and contributions of Kelly Paulson, Leanne Sandieson, Dawn Schaber-Goa, Alex Ferguson, Tessa Kroeninger and Brett Milazzo (study coordinators) as well as Leah Verderame, Elyse Mueller and Kelly Bandilli (men's health nurses).

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EDITORIAL COMMENTS

Postprostatectomy erectile rehabilitation is one of the most important prostate cancer survivorship issues. There is currently no consensus on the optimal rehabilitation protocol, as previous studies have

generally been inadequate or inconclusive. Many protocols include the use of pharmacotherapy with mechanical therapy such as with vacuum erection devices. Penile traction therapy is an emerging mechanical therapy that has shown promising data in men with erectile dysfunction secondary to Peyronie's disease from the same investigators (reference 12 in article). Interestingly, ED in men with Peyronie's shares many of the pathophysiological mechanisms with postprostatectomy ED, including neurovascular injury, hypoxia, inflammation, corporal fibrosis and veno-occlusive dysfunction.

In this manuscript, Toussi and colleagues share the results of a rigorous, randomized controlled trial from the Mayo Clinic evaluating the utility of a novel PTT device they invented called RestoreX in increasing penile length and preserving erectile function after prostatectomy. This cohort of relatively young post-prostatectomy men (mean age 58.6) were randomly assigned to control without a sham treatment (25) or PTT (30) over a short followup of 6 months.

Those who underwent PTT in this single-blinded RCT demonstrated greater preservation of penile length. The PTT group also demonstrated greater preservation of erectile function, although the effect was not observed among the subset of patients with baseline ED. Additionally, PTT resulted in less use of erectogenic pharmacotherapy, greater intercourse satisfaction and greater overall sexual satisfaction. Since PTT is both well-tolerated and readily accessible to many patients, these data will come as welcomed news both to patients and surgeons.

The treatment effect of any RCT can be magnified without double blinding due to bias.[1] However, the extraordinary effort to implement this interventional RCT is commended, and the contributions of these investigators and patients will likely advance the field. Followup data from other centers will be highly anticipated.

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Erectile dysfunction and penile shortening continue to be significant adverse effects of radical prostatectomy.[1] Over the past few decades multiple studies evaluating surgical techniques and rehabilitation regimens to preserve post-radical prostatectomy erectile function and penile length have been done. Two prior studies by Raina et al[2] and Köhler et al (reference 10 in article), examined sexual function and stretched penile length after vacuum device use in men after radical prostatectomy. Both studies demonstrated improved sexual function and stretched penile length after radical prostatectomy in men who used the devices; however, long-term outcomes were not assessed. Despite prior studies evaluating the effectiveness of VED, PDE5 or ICI in penile rehabilitation post-radical prostatectomy, few studies have demonstrated long-term effectiveness of these interventions in preserving erectile function or penile length. Interestingly, no prior studies have examined the effects of penile traction therapy after radical prostatectomy.

In the current article, Toussi et al performed a randomized, controlled trial examining the use of a novel penile traction therapy device in men post-radical prostatectomy. The primary outcome was change in stretched penile length; secondary outcomes were change in erectile function scores, adverse events and subjective satisfaction. Stretched penile length and erectile function (including spontaneous erections) were significantly better in the traction group. Additionally, adverse events secondary to PTT were transient and mild.

The findings are promising in that a minimally invasive device potentially may aid in preserving penile length and erectile function post-radical prostatectomy. Although no mechanistic information is provided, the improvement in erectile function is significant despite the traction group reporting less PDE5 or ICI use. Given the reported ease of use of this device, minimal adverse effects and potential benefit to patients in preserving penile length and erectile function, use of this therapy in men after radical prostatectomy should be considered. Collaborating studies will be required to confirm these findings, and long-term data will be eagerly anticipated.

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REPLY BY AUTHORS

We greatly appreciate the comments by Drs. Coward, Kang, and Kashanian. Please note Dr. Trost's and Mayo Clinic's conflict of interest as the inventor and development site of the technology, respectively. The key finding of this study is that early use of RestoreX PTT results in a higher rate of preserved erectile function post prostatectomy. If validated externally, this would represent the first (in high-level studies) true advancement in postprostatectomy erectile function "rehab" since nerve-sparing techniques. Importantly, no other therapy has shown similar findings. Two PDE5s have been evaluated in industry-sponsored, powered, RCT studies and demonstrated no differences in spontaneous erectile function when PDE5s were not used (references 8 and 9 in article). Similarly, the 2 VED studies cited did improve erections when the devices were used during intercourse, but did not change spontaneous erectile function rates. Despite these negative data, PDE5s and VEDs are commonly incorporated in penile rehabilitation protocols.

We also agree that certain biases could not be controlled, including creation of a viable sham and inability to blind participants. However, given that the data are similar to 2 other RCTs in different populations (Peyronie's [published], diabetes [recently completed, abstracts only]), lower use of erectogenic aids, lack of clinician impact on self-completed IIEF questionnaires, and recent findings from Hellstrom's group suggesting a possible mechanism (rat study demonstrating increased nitric oxide synthase with traction),[1] these data appear to report a consistent and legitimate finding. If validated externally, these results may represent a notable advancement in postprostatectomy erectile function rehabilitation as well as a potential new avenue for future erectile dysfunction research and treatments.

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