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Pharmacologically induced erect penile length and stretched penile length are both good predictors of post-inflatable prosthesis penile length

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Abstract

Inflatable penile prosthesis (IPP) remains the gold standard for the surgical treatment of refractory erectile dysfunction; however, current literature to aid surgeons on how best to counsel patients on their postoperative inflated penile length is lacking. The aim of this study was to identify preoperative parameters that could better predict postoperative penile length following insertion of an IPP. Twenty men were enrolled in a prospective study examining penile lengths before and after IPP surgery. Patients with Peyronie's disease were excluded from this analysis. Baseline preoperative characteristics, including body mass index, history of hypertension, diabetes, Sexual Health Inventory for Men scores and/or prior radical prostatectomy were recorded. All patients underwent implantation with a three-piece inflatable Coloplast penile prosthesis. We compared stretched penile length to pharmacologically induced erect lengths. Postoperatively, we measured inflated penile lengths at 6 weeks and assessed patients' perception of penile size at 12 weeks. The median (\pm interquartile range) stretched penile length and pharmacologically induced erect penile length was 15 (\pm 3) and 14.25 (\pm 2) cm, respectively ($P = 0.5$). Median post-prosthesis penile length (13.5 \pm 2.13 cm) was smaller than preoperative pharmacologically induced length ($P = 0.02$) and preoperative stretched penile length ($P = 0.01$). The majority of patients (70%) had a decrease in penile length (median loss 0.5 \pm 1.5 cm); however, this loss was perceptible by 43% of men. Stretched penile length and pharmacologically induced erect penile length were equally good predictors of postoperative inflated length (Spearman's correlation 0.8 and 0.9, respectively). Pharmacologically induced erect penile length and stretched penile lengths are equal predictors of post-prosthesis penile length. The majority of men will experience some decrease in penile length following prosthesis implantation; however <50% report a subjective loss of penile length.

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CONFLICT OF INTEREST

JFE receives compensation as a consultant for Coloplast Inc. All other authors declare no conflict of interest.

Keywords

erectile dysfunction; penile length; penile prosthesis; stretched penile length

INTRODUCTION

Erectile dysfunction (ED) is a common disease that affects >500 000 men annually.¹ With the overall increasing incidence of diabetes, obesity and cardiovascular-associated comorbidities in the United States, ED certainly will remain a prevalent disease that impacts quality of life and could be a predictor of overall cardiovascular health.²

Current treatment(s) for ED include vacuum-erection devices, type 5 phosphodiesterase type 5 phosphodiesterase inhibitors, intraurethral prostaglandin E1 and intracavernosal injection (ICI). Penile prosthesis implantation remains the gold standard for patients who do not respond to or fail medical treatment for ED.

Inflatable penile prostheses (IPP) have excellent long-term patient satisfaction rates, generally above 90%.³ Patient satisfaction is often centered around erectile function, penile length, cosmetic outcome and partner acceptability.⁴ Despite patient's overall satisfaction, some patients may complain of a subjective reduction in postoperative penile length,^{5,6} despite the fact that most men have similar penile length.⁷ To this end, surgeons have attempted augmentation techniques to improve girth, reduce pubic fat pad size and increase glans firmness; however, long-term follow-up data is lacking.^{8,9} Ultimately, appropriate patient selection, proper preoperative counseling and setting realistic expectations may improve overall patient satisfaction.

Several authors have examined the relationship between preoperative penile length via stretch¹⁰ or ICI,¹¹ and post-prosthesis penile length; however, to our knowledge there are no studies comparing ICI versus stretched penile length to postoperative inflated penile length.

Aims

In this study, we prospectively evaluated 20 men who underwent initial IPP surgery. We hypothesized that preoperative pharmacologically induced erect penile length would be the best predictor of postoperative inflated penile length. Our primary outcome was comparing post-prosthesis penile length to various preoperative measurements. Our secondary outcome was the subjective assessment of penile length loss and patient perception.

MATERIALS AND METHODS

Twenty consecutive patients underwent preoperative evaluation with informed consent of our study protocol by a single surgeon from April to August 2012. Intake history and physical were conducted, including the presence of diabetes, cardiovascular disease, including hypertension, and hyperlipidemia. All patients completed a Sexual Health Inventory for Men questionnaire.¹² A prior surgical history, including a history of radical prostatectomy, was recorded. Complete examination of penile length was performed. Measurements included flaccid penile length—the distance from the pubic bone toward the

tip of glans penis in centimeters—as well as the pharmacologically induced erect penile length in centimeters. To achieve a pharmacologically induced erection, 10 µg of alprostadil, a prostaglandin E1 agonist was used. After tumescence, the erect length was measured. Additional intracavernosal dosing of alprostadil in increments of 5 µg was used when necessary, to facilitate an erection firm enough for sexual penetration. The maximal amount of alprostadil used was 25 µg. Nonresponders to ICI and men using a vacuum-erectile device preoperatively were excluded from this study. Penile duplex sonography was performed to measure cavernous artery diameter, peak systolic velocity and cavernous artery end diastolic velocity.

All patients underwent a three-piece inflatable Coloplast (Minneapolis, MN, USA) penile prosthesis using a peno-scrotal approach by a single surgeon (JFE). Preoperative antibiotic prophylaxis was used according to the American Urologic Association best practice guidelines.¹³ The No-Touch-technique was used in all cases in effort to reduce postoperative infection rates.^{14,15} Intraoperative cylinder sizing was performed in a standardized manner in all cases. First, corporal dilation is performed after corporotomy with the blunt tips of a long curved Mayo scissors followed by a 13/14 Hegar dilator. Next, a Dilamezinsert is used to measure the distal and proximal corporal lengths to the edge of the corporotomy as a fixed point of reference. Caution is taken not to overstretch the penis or alter our traction stitch in the corporotomy, which may lead to oversizing. Patients are discharged with the implant partially inflated with the penis placed in an upright position against the abdomen via a jockstrap. Around 3–4 weeks postoperatively, patients will begin cycling the device.

At 6 weeks postoperatively, patients' post-prosthesis inflated penile length was recorded, measuring from pubic bone to the tip of the glans penis. At 12 weeks postoperatively, patients returned to the office to complete a questionnaire assessing their satisfaction (see Appendix 1).

Main outcome measures

Comparisons were made between preoperative and postoperative penile measurements using a χ^2 -test, paired *t*-test, Wilcoxon rank-sum test and Spearman's tests as indicated. Statistical significance was defined as a *P* < 0.05. All statistical analysis was done using SPSS v20.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

The demographic and baseline characteristics of the 20 men in this study are reported in Table 1.

The median (interquartile range) preoperative stretched penile length was 15 (± 3) cm and was similar to pharmacologically induced erect penile length (14.25 (± 2) cm; *P* = 0.5). After IPP implantation, the median (interquartile range) inflated penile length was 13.5 (± 2.13) cm at 6 weeks. The median (interquartile range) cylinder size placed intraoperatively was 22 cm (± 4 cm). Fourteen patients (70%) had a smaller (0.5 ± 1.5 cm) postoperative penile length when compared with their pharmacological-induced penile length (*P* = 0.02). There was also a decrease in penile length after implantation compared with preoperative

stretched penile length (15 ± 3 vs 13.5 ± 2.13 cm; $P = 0.01$). At 6 weeks, no patient had developed a supersonic transportation-like deformity.

Of all the preoperative factors examined and/or measured, preoperative stretched penile length and pharmacologically induced erect penile length were equal predictors of postoperative penile length by linear regression and Spearman correlation. (Table 2) The difference between these correlation coefficients was not significant (0.8 vs 0.9 , $P > 0.05$).

Of the 20 patients, 12 men had a measured difference of 1 cm or more between their preoperative pharmacologically induced erect penile length and postoperative inflated penile length. Patients with a prior history of radical prostatectomy were more likely to have a length discrepancy of >1 cm (42% vs 0% , $P = 0.04$; Table 3).

At 12 weeks postoperatively, 86% of men subjectively perceived a change in penile length following IPP implantation, of which 43% perceived a smaller postoperative penile size and 43% perceived a larger penile length. Of those men who reported a subjective change in size, 57% had an objective decrease in their postoperative penile length ≥ 1 cm when compared with their pharmacological induced penile length, suggestive that 14% of men did not perceive a preoperative to postoperative size discrepancy. Of this select cohort reporting a subjective and objective decrease in size, 66% had undergone a prior radical prostatectomy.

DISCUSSION

Men undergoing penile prosthesis implantation should be counseled on their expected postoperative penile functionality and size; however, only a few studies exist guiding physicians with evidence on which preoperative factors best predict postoperative penile size.

In this study, our primary aim was to evaluate preoperative and postoperative penile lengths and compare which measurements were predictive of penile length at 6 weeks postoperatively. Our secondary aim was to describe the relationship between objective versus subjective loss in penile length.

Here we present a prospective cohort of 20 patients who underwent first-time Coloplast Titan three-piece inflatable penile prosthesis (IPP) by a single surgeon (JFE) from April 2012 to August 2012. We found that both stretched penile length and pharmacologically induced erect penile length are excellent predictors of postoperative inflated penile length ($R = 0.8$ and 0.9 , respectively). Surgeons may find performing ICI advantageous over stretched penile length because it allows for examination of penile anatomic abnormalities (that is, extent of curvature and/or hour-glass deformity), which may be useful before prosthesis insertion. The majority of men will experience an objective decrease in penile length after prosthesis insertion (median loss 0.5 ± 1.5 cm); however, this discrepancy was perceptible only in 43% of men.

To our knowledge, this study is the first to compare the performance of both stretched penile length and pharmacologically induced erect penile length in the same cohort to inflated

penile length measurements. A prior study by Wessells *et al.*¹⁶ prospectively compared flaccid, stretched and pharmacological-induced penile lengths in 80 men. Their data similarly confirm a close correlation between stretched and pharmacologically induced penile length (correlation coefficient = 0.8 vs 0.83 in our data set). This cohort, however, did not undergo IPP implantation.

Deveci *et al.*¹⁰ first examined stretched penile lengths versus post-prosthesis erect penile lengths in 56 men undergoing first-time implantation secondary to a variety of etiologies. Surprisingly, there was no statistical difference noted between pre- and postoperative penile lengths objectively; however, 72% of patients reported subjective length decreases, which corresponded to lower satisfaction domain scores. This is contrary to our results whereby there was a statistically significant difference in postoperative penile lengths versus preoperative stretched penile lengths and pharmacologically induced erect length. Our findings are consistent with other literature denoting a mean penile length decrease of 0.8 cm following prosthesis implantation.¹¹ The mechanism of penile shortening following IPP surgery is not completely understood; however, it is likely multifactorial: improper sizing during surgery, improper pre/postoperative measurements and lack of engorgement of the glans and/or fibrosis. To address the lack of engorgement of the glans, some authors advocate concomitant type 5 phosphodiesterase inhibitor use¹⁷ or intraurethral alprostadil.¹⁸ Other authors release the penile suspensory ligament at the time of IPP insertion¹⁹ or removal of any penoscrotal webbing;⁹ however, these studies were not designed to compare preoperative versus postoperative penile lengths. Most recently, Henry *et al.*²⁰ described a new penile implant length measurement technique whereby a greater number of men received a larger implant size without any reported distal erosions. Lastly, girth and length expanding cylinders have been used to counteract the loss in penile length following prosthesis;²¹ however, these devices have been fraught with mechanical failures and S-shaped deformities.^{22,23}

Interestingly, our cohort reported less subjective loss compared with the study by Deveci *et al.*¹⁰ (43% vs 73%), despite cohorts having roughly equal number of men (25% vs 28.5%) who had undergone prior radical prostatectomy. One explanation for why subjective assessment of penile length does not fully reflect objective length discrepancy is that with sexual activity some glans engorgement may occur that would not be apparent during office-based examination.

To examine the relationship between pharmacologically induced erect length and inflated penile length, Wang *et al.*¹¹ in 2009 prospectively enrolled 11 patients with ED secondary to neurogenic etiologies. Preoperative ICI with 0.25 ml of Trimix was compared with postoperative penile prosthesis lengths at 6 weeks, 6 months and 1 year. The authors report a statistically significant decrease in postoperative length of 0.83 cm at 6 weeks. There was no statistical difference in inflated penile lengths at 6 months or 12 months when compared with the initial postoperative measurement at 6 weeks. Although all patients in their cohort had a decrease of erect penile length (range 0.2–3.0 cm), only 45% reported a subjective decrease in post prosthesis. Although our cohort demonstrates similar objective measurements and subjective perceptibility data, we report three patients having an increase in postoperative penile length.

Current literature demonstrates that penile length is reduced after prostatectomy even after penile prosthesis implantation.^{24,25} In fact, several studies report that a prior radical prostatectomy was the only demographic factor that statistically differed for those patients complaining of length loss,¹⁰ and men with a history of radical prostatectomy have lower overall erectile satisfaction postoperatively.⁵ The rationale for this phenomenon is likely due to neuropraxia secondary to nerve damage and/or decreased arterial inflow from ligation of the accessory internal pudendal arteries leading to ischemic apoptosis.^{26,27} We found that a prior history of a radical prostatectomy was the only factor that significantly impacted a preoperative to postoperative length discrepancy >1 cm ($P = 0.04$). However, we did find that the majority of men who denoted subjective loss in penile length had undergone prior radical prostatectomy (66%).

This analysis is limited by a small sample size of 20 men who were operated on by a single surgeon at a single center with a single model of prosthesis. Patients with Peyronie's disease were excluded from this cohort representing inherent selection bias. One individual that was blinded to our study protocol measured all preoperative and postoperative penile lengths without secondary confirmation. Patients were followed for a maximum of 12 weeks postoperatively; however, current literature shows no statistical difference in inflated penile lengths after 6 weeks.^{10,11} Although the Sexual Health Inventory for Men questionnaire was administered to all patients in the preoperative setting, a non-standardized questionnaire was used to assess patients' postoperative satisfaction.

CONCLUSION

Preoperative pharmacologically induced erect penile length and stretched penile lengths are equal predictors of post-prosthesis inflated penile length. ICI may be advantageous for preoperative assessment of penile anatomy; however, peak systolic velocity and end diastolic velocity were not predictive of postoperative inflated length. Even though the majority of patients will experience some decrease in penile length following prosthesis implantation, <50% of men perceive such discrepancy. Setting realistic expectations with informed decision-making and proper preoperative counseling will lead to improved outcomes and patient satisfaction.

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APPENDIX 1

Questionnaire completed by patients at 12 weeks post operatively.

1. When your penis is flaccid (soft), do you feel like it is bigger, smaller, or the same as compared with that before your operation (circle one)?
2. When your penis is erect (hard) after inflation of your prosthesis, do you feel like it is bigger, smaller, or the same as compared with that before your operation (circle one)?

Table 1

Baseline demographic characteristics

	<i>N</i> = 20
Median age (IQR)	61.5 (\pm 8)
HTN	9 (45%)
Diabetes	8 (40%)
Hyperlipidemia	10 (50%)
Prior radical prostatectomy	5 (25%)
Median preoperative SHIM scores (IQR)	4 (\pm 6.5)
Median flaccid penile length cm (IQR)	10.25 (\pm 4)
Median stretched penile length cm (IQR)	15 (\pm 3)
Median erect penile length after ICI, cm (IQR)	14.25 (\pm 2)
Median cylinder size cm (IQR)	22 (\pm 4)
Median EDV ml s ⁻¹ (IQR)	6.7 (\pm 4.7)
Median PSV ml s ⁻¹ (IQR)	36.3 (\pm 21)

Abbreviations: EDV, end diastolic velocity; HTN, hypertension; ICI, intracavernosal injection; IQR, interquartile range; PSV, peak systolic velocity; SHIM, Sexual Health Inventory for Men.

Table 2

Predictors of post-operative penile length

Predictors of postoperative inflated penile length	Linear regression	P-value	Spearman correlation coefficient	P-value
Stretched penile length	0.71	<0.001	0.8	<0.001
Pharmacologically induced erect penile length	0.83	<0.001	0.9	<0.001
Median PSV	-0.04	0.66	-0.07	0.76
Median EDV	-0.05	0.97	0.08	0.73

Abbreviations: EDV, end diastolic velocity; PSV, peak systolic velocity.

Table 3

Preoperative predictors of changes in preoperative to postoperative penile lengths

	1 cm Discrepancy (n = 12)	<1 cm Discrepancy (n = 8)	P-value
Median age	60.5 ± 5.75	65.5 ± 12.75	0.2
HTN (%)	42%	50%	0.71
Diabetes (%)	50%	25%	0.26
Hyperlipidemia (%)	67%	25%	0.07
Prior radical prostatectomy (%)	42%	0%	0.04
Median Preoperative SHIM scores	1.5 ± 5.5	5 ± 3.5	0.28

Abbreviations: HTN, hypertension; SHIM, Sexual Health Inventory for Men.